FUEL COMPOSITIONS EMPLOYING CATALYST COMBUSTION STRUCTURE

Field of the Invention

The present invention is a CIP of my US Application 08/986,891 (Fuel Compositions Exhibiting Improved Fuel Stability, filed December 8, 1997) and relates to a broad spectrum of pollution reducing, improved combustion performance, and enhanced stability fuel compositions for use in jet, aviation, turbine, diesel, gasoline, and other combustion applications. More particularly, the present invention relates to fuel compositions employing certain co-combustion agents, including trimethoxymethylsilane.

Background of the Invention

Growth in environmental concerns related to pollutants generated by hydrocarbon based fuels, especially emissions related to greenhouse gases, has given raise to the need to find new fuels and methods of combustion capable of reducing such emissions, namely carbon dioxide, nitrous oxide (NxO), NOx, methane, ozone, CFC's, halons and similar gases. Increases of nitrous oxide gases occurring post exhaust catalyst have recently been discovered. Similar to CFC's, nitrous oxides are about a 1000 times more potent than CO2 in their adverse effect. It has been found the effect of the exhaust catalyst, itself,

may actually tend to increase the concentrations of nitrous oxides. Thus, there is a current need to reduce overall nitrous oxide emissions and additionally find a means reducing the effect the exhaust catalyst has upon increasing said emissions.

International Patent Applications, PCT/US95/02691, PCT/US95/06758, and PCT/US96/09653, incorporated in their entirety herein by reference, speak to a new form of combustion known as metallic vapor combustion, wherein combustion does not take place on the surface of the metal, or on and/or within the molten layer of oxide covering the metal, typical of heretofore metallic combustion. Rather, combustion is characterized as being highly, with a luminous reaction zone extending some distance from the metal's surface or the normal flame front, at a high burning rate, wherein metallic oxide particles are formed in the submicron range.

This is a highly expansive brillant type of combustion, where for example the laminar flame of a Bunsen burner shows an extended luminous zone to extend beyond the boundary of the normal flame front. This combustion yields vastly accelerated flame/exhaust gas velocities compared to traditional combustion, in turn generating greater amounts of useable free energy.

Said PCT Applications disclose fuel compositions and combustion techniques achieving vapor phase combustion based on an enhanced combustion structure ("ECS"), which incorporates a free radical generating oxygenate compound("ECS oxygenate") and a high energy combustible non-lead metallic, preferably an "ECS metallic" containing ECS structure. Applicant's metallic together with an ECS compound yield vapor phase combustion. In the aforementioned Applications and herein metallic shall mean at least one non-leaded element or derivative organic or inorganic compound containing said non-lead element, selected from the group consisting of 1A, 2A, 3B, 4B, 5B, 6B, 7B, 8, IB, 2B, 3A, 4A, 5A, 6A, or 7A elements of the Periodic Chart of Elements (CAS version), and mixture, wherein said element or derivative compound, is combustible, and optionally has a minimum heating value of 4,000 Kcal/kg, and wherein vapor phase combustion occurs. As noted, in the aforementioned Applications and herein, an ECS metallic is a metallic capable of increasing burning velocity and/or reducing combustion temperature. It is any non-lead metallic (or non-metallic) which may be employed in the practice of this invention. Said metallic may be employed with hydrogen or a hydrocarbon fuel, absent an ECS compound.

As set forth herein "ECS metallic" can be read as any

non-lead metallic (and non-metallic as set forth below), or any organic or inorganic derivative thereof, which accomplishes the vapor phase combustion object of this invention. As set forth in the disclosure below ECS metallic contemplates any metallic or non-metallic accomplishing this object. An ECS metallic need not contain ECS structure (e.g. high kinetic energy free radicals), albeit said ECS structure is preferred. A "non-lead element or derivative" herein shall also be read as "ECS metallic."

It is noted, a principal ECS metallic of the aforementioned PCT applications was manganese, chiefly methylcyclopentadienyl manganese tricarbonyl. Due to recent concerns over the neurotoxicity of manganese combustion products, and the potential neurotoxicity of other combustion metal oxides, a need exists to find a high energy, non-manganese, non-neurotoxic replacement ECS metallic or group of metallics capable of achieving vapor phase combustion.

<u>Example A</u>

A fuel composition containing hydrogen or a hydrocarbon fuel and at least one organic or inorganic compound containing a non-lead element, selected from the group consisting of 1A, 2A, 3B, 4B, 5B, 6B, 7B, 8, IB, 2B, 3A, 4A, 5A, 6A, or 7A elements

of the Periodic Chart of Elements (CAS version), wherein said non-lead derivative compound simultaneously increases combustion burning velocity and/or reduces combustion temperature, wherein said composition is improved over the hydrogen or the co-fuel alone; optionally showing improved thermal efficiency. Said composition optionally containing an ECS oxygenate.

As noted, in the aforementioned Applications, Applicant has discovered, under these his combustion conditions, the metallic, itself, becomes an integral and powerful agent in the combustion process, improving combustion thermal efficiencies, translating into improved fuel economy, net available, work, power generation, thrust, and the like (e.g.increased miles/gal. (kilometers/liter), increased flight range/Kg, increased kilowatts generated/liter), while simultaneously reducing hazardous pollutants.

In the context of this invention, Applicant generally refers to thermal efficiency in both its chemical and mechanical context, e.g. the efficiency of the chemical reaction and the amount of useful work generated in the system, e.g. free energy.

Applicant has found, thermal efficiency, particularly as

measured as a function of net useful work generated by the system is increased. Often substantially.

For example, Applicant's has discovered thermal efficiency improvements over existing unadjusted fuels and combustion systems to be on the order of 0.5%, 1.0%, 2.0%, 3.0%, 4.0%, 5.0% to 20%. And, depending upon the circumstances (e.g. combustion systems, fuel configurations) average improvements can range from 2.0% to 5.0%, 5.0% to 10.0% or higher, with modest improvements ranging from 0.05% to 1.0% to 2.0%. Exceptional improvements will range from 10%, 25% to 40%, 30% to 80%, or more.

In the context of this invention "unadjusted" fuels mean conventional existing hydrocarbon fuels concurrent to this invention, which have not been adjusted to improve burning velocity, increase latent heats of vaporization, T-90 temperatures, mid range distillation temperatures, aromatic or sulfur contents. These value are variously set forth herein and to the extent they are known in the industry incorporated herein by reference.

Example B

The compositions of Example A, containing hydrogen or a hydrocarbon, wherein said composition's burning velocity

and/or combustion temperature permit said non-lead derivative compound to replace need for an ECS compound, however, said composition experiencing luminous vapor phase combustion.

Example C

The aforementioned compositions, wherein said non-lead derivative is a sodium, potassium, phosphorous, boron, or silicon derivative, including mixture.

Example D

The aforementioned composition, wherein said non-lead derivative is trimethoxymethylsilane or homologue, analogue, isomer or derivative.

The aforementioned PCT Applications speak to the use of symmetrical alkyl carbonates (e.g. dimethyl carbonate "DMC") . as a preferred ECS oxygenate, which the art discloses as having potential hydrolytic or stability problems when in an acidic or aqueous environments. See for example, EPO Application # 91306278.2 Karas, which reasonably suggests fuels containing a symmetrical diakyl-carbonate, like DMC, which have pH's perhaps 11 or lower, as being potentially problematic. Thus, there is a need to mitigate this potential fuel stability problem.

Additionally, the use of less expensive longer chain or

more complex, viscous fuels, e.g., heavy oils, heavy fuel oils, diesels, etc., have attendant handling, emission and combustion problems, which warrant solution, especially if solved simultaneously with the above related problems.

Summary of the Invention

The instant invention resides in an improvement to the aforementioned PCT Applications, and simultaneously solves the noted problems. Namely, the invention reduces combustion greenhouse gases of C02, NOx, ozone, methane, and problematic chlororfluorocarbons and nitrous oxides. The invention, is particularly able to control and reduce NOx emissions generated post exhaust emissions catalyst.

The invention also beneficially improves a broad class of combustion systems and emissions in general, while simultaneously improving fuel economy, flight range, thrust and/or power.

The invention more particularly relates to discovery of a class of non-manganese, non-toxic ECS metal and metalloid compounds, including a combination thereof, capable of achieving vapor phase combustion, but which do not have manganese's associated neurotoxicity problem. Metallics of particular interest include alkali/alkali earth metals, sodium,

potassium, boron, aluminum, silicon and phosphorus.

The invention resides in the combination of metallics, metalloids (herein after nonlead element compounds "NLEC's") which include combining an ECS metallic with and ECS co-combustion metal, metalloid, or carbon catalyst structurally similar to triemethoxymethylsilane or dimethyl-phosphite. Said catalyst is contemplated in combination with Applicant's ECS metallics to improve vapor phase burning, achieving the objects of this invention.

The invention further resides in discovery of a means of maintaining stability of fuels containing symmetrical lower dialkyl carbonates, while simultaneously improving the handling of fuels containing alkali/alkali earth metals, which can be highly alkaline. In accordance therewith, the fuel compositions of the present invention exhibits improved stability and handling attributes when the fuel compositions are constructed to a weakly alkaline (7.5 to 11.0 pH), substantially neutral (6.5 to 7.5 pH), or slightly acidic (4.5 to 6.9 pH) environments, whether or not water is present. In such cases there is no handling hazard or hydrolysis problem. Thus, in the case of symmetrical lower dialkyl carbonate containing fuels, long term storage is possible absent any

deterioration of stability. Likewise the handling hazards of strongly alkaline compositions due to the presence of alkaline or alkaline earth metals is additionally controlled.

Additionally, it has been discovered the presence of lower dialkyl carbonates and ECS metals in the fuel compositions of the present invention allow for the use of highly viscous base hydrocarbon fuels, which otherwise might not be used.

Detailed Description of the Present Invention

ECS COMPONENTS

The free radical generating ECS oxygenates of this invention include C2 - C12 aldehydes (including aldehydic acids), C2 -C12 ethers (including ether acids), C3 to C15 di-ethers, Cl - C15 alcohols, C2 - C12 oxides, C3 - C15 ketones, ketonic acids, C3 - CIS esters (alkyl formates, acetates, diacetates, butyrates, etc.), othroesters, C3 -C12 diesters, C5 -C12 phenols, C3 - C20 glycol ethers, C2 -C12 glycols, C3 - C20 alkyl carbonates, C3 - C20 dialkyl carbonates, C3 - C20 asymmetrical alkyl/dialkyl carbonates, C3 - C20 di-carbonates, Cl to C20 organic and inorganic peroxides, hydroperoxides, carboxylic acids (including formic acids), amines, nitrates, di-nitrates, oxalates, phenols, glacial acetic acids (including C3 to C8 hyrodoxy esters of acetic acid, anhydrides,

methoxy methyl ester of acetic acid, etc.), boric acids, orthoborates, hydroxyacids, orthoacids, anhydrides, acetates, acetyls, methyl esters, nitrates, di-nitrates, nitro-ethers. Applicant's ECS compounds increasing burning velocity and/or increase latent heat of vaporization, and those that are set forth in the aforementioned prior references are incorporated by reference.

Applicant's ECS oxygenated compounds which include one to ten oxygen atoms are desireable, with to one to three oxygen atoms more desirable. If organic, those oxygenated compounds having carbon atoms of one to 20 atoms are desireable, with one to ten more desireable, with one to five being yet more preferred. Those with three atoms or less are most preferred. Compounds where oxygen represents 10%, 20%, 30%, 40%, or more, by weight are desired. Specific oxygenated compounds can be found in detail in Organic Chemistry 6th Ed, T.W.G. Solomons, John Wiley & Sons, N.Y., (1995), Physical Chemistry, 5th Ed, P.W. Atkins, Oxford University Press, U.K. (1994), Physical Organic Chemistry, 2 Ed, N.S. Issacs, John Wiley & Sons, N.Y. (1995) and Lange's Handbook of Chemistry, 14th Ed, J.A. Dean, McGraw-Hill, N.Y. (1992).

ECS oxygenates of particular interest (homologues,

analogues, derivative, and isomers thereof), include tertiary hydrocarbyl ethers, including but not limited to methyl tertiary butyl ethers (MTBE), ethyl tertiary butyl ether (ETBE), tertiary methyl amyl ether (TAME), tertiary methyl ethyl ether (TEME), ethyl, tertiary amyl ether; C1 to C6 aliphatic alcohols, including but not limited to ethanol, methanol; lower diakyl carbonates, including but not limited to dimethyl carbonate (DMC) , diethyl carbonate (DEC); ethers having dual linkage (e.g. diethers), including but not limited to di-ethers, including methyal (methylene di methyl ether or dimethoxy methane), ethylal (diethoxy methane); carbons having multiple alkyloxy groups, including but not limited to tetramethoxymethane, tetraethoxymethane, anhydrides and hyrodoxy esters of acetic acid, anhydrides, including but not limited to methoxy methyl ester of acetic acid, ethoxy methyl ester of acetic acid.

Applicant's ECS oxygenated compounds may be included in weight percent of the final composition in that amount, which results in optimal vapor phase combustion. Concentrations ranging from 0.5, 1.0, 1.5, 2.0, 2.1, 2.2, 2.5, 2.7, 3.1, 3.4, 3.5, 3.6, 3.7, 4.0, 4.5, 5.0 percent weight by oxygen are contemplated. Other oxygen concentrations range from 0.01 to 3.7, 0.1 to 80.0, 1.0 to 5.0, 1.0 to 10.0, 1.0 to 15.0, 1.0 to

20.0, 1.0 to 30.0, 1.0 to 40.0, 1.0 to 53 percent oxygen by weight in the composition.

Preferred ECS structure/components (e.g. oxygenates, metallics, and hydrocarbon base, if any) are characterized as those yielding in precombustion a significant portion of reactive high kinetic energy free radicals (e.g. H, H_2, O, 00, CO, F, F2, F3, N, B, Be, BO, B2, BF, AL ALO, CH3, NH3, CH, C2H2, C2H5, Li, KO, KOO, ONH, ON, NH, NH2, OCH_3, OCH,OCH_2, OH, Cl, CN, OCOO, COOH, C2H5OOC, CH3CO, OCH20, OCHCO, or CONH2), as a weight percent of their total precombustion vapors. Thus, components containing one or more of these radicals is desired. Preferred weight percent contributed by the substituent is equal to or greater than 2%, 5%, 10%, 20%, 30%, 40%, of the precombustion vapors. Similarly Applicant's ECS compounds should contain one or more radicals of same structure.

The preferred reactive high kinetic energy free radicals of this invention are those radicals that generate laminar bunsen flame velocities in excess of 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 70, 75, 80, 90 or more, cm/sec, (laminar bunsen burner flame with methanol at a 57.2 cm/sec bench mark), more preferably in excess of 50, 60, 65, or 70 cm/sec., and ideally

those having at least one free or unused valency electron; said ideal radical is characterized as being a chain carrier in the main chain reaction of combustion, effectively disassociating and re-associating during combustion. As used herein flame velocity or propagation is the art definition, which can be defined as the volumetric velocity of the stream of the combustible mixture divided by the surface of the inner cone of a laminar Bunsen flame. As contemplated herein and in the examples below, said noted flame velocities (for ECS compound) may be translated to the finished fuels themselves (e.g. finished fuels may have a burning velocity of 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 70, 75, 80, 90 or more, cm/sec. As contemplated herein, these laminar flames values are measured using the internal angle of the Bunsen flame, which are parallel to the external vertical (flowing) flame wall to the peak of the flame head, thus compensating for the luminous zone, which masks the normal outer edge and peak of the flame head of the flame which may also be used to measure flame velocities (see Figure 1).

Thus, the preferred ECS oxygenates, metallics, and/or hydrocarbon bases, if any, have higher relative flame

velocities. As a rule, when combusted in air (as a function of their own constitution and as measured in a laminar Bunsen flame), flame velocities should equal or exceed 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 65, 70, 75, 80, 85, 90, 100, 110, 120, 130, 140, 150 cm/sec., with those exceeding 40, 41, 42, 43, 45, 47, or more, preferred. The higher the burning velocity the better. It is recognized individual ECS oxygenates may have higher burning velocities than individual metallics, compared to hydrocarbon base fuels. However, ESC oxygenate/metallic combinations should have synergistic laminar burning velocities preferably exceeding 48, 50, 55, 60, 65, 70, or more cm/sec.

FIGURE 1

FIGURE 1 shows the method of calculating laminar burning'[1] velocity (LHV or BV) employing a Bunsen Burner, and the differences seen between a conventional (clear), fuel flame compared to a luminous flame. Burning velocity is calculated as ½ Sin of the interior angle (Θ) at the head of the flame (times) the gas velocity (VG), or BV.

Laminar Flame Velocity (LFV) and Burning Velocity (BV) are interchangeable terms herein. In the case of luminous flames,

0 measurements (the angle found at the flame peak) are made inside below the luminous portion of the flame (see Fig 1) .

BV calculations may be adjusted for temperature and pressure. Higher pressures reduce measurable BVs while higher temperatures increase them. As provided herein, BV values herein are those that would be equivalent to those with methanol being benchmarked at 57:2 cm/sec.

Preferred latent heats of vaporization of ECS components (e.g. oxygenates, metallics, and/or hydrocarbon bases) at 60°F are those equal to or greater than 60, 75, 80, 85, 90, 95, 100, 1,05, 110, 115, 120, 125, 130, 135, 140, 145, 150, 155, 150, 160, 165, 170, 180, 190, 200, 210, 220, 230, 240, 250, 270, 290, 300, 325, 350, 375, 400, 425, 450, 475, 500 btu/lb, or more. Those greater than 100, 115 btu/lb are more desireable. Alternatively, preferred latent heats of vaporization (enthalpy of vaporization at boiling point) equal to or greater than 21, 22, 23, 24, 26, 27, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 40, 42, 43, 45, 47, or higher, jK mole^{-1} are desireable, with those' no less than 28.0 jK mole^{-1}, more desireable. The higher the latent heat of vaporatization the better. It is an embodiment of this invention to employ hydrocarbon bases having enhanced LHV's (see below).

The ECS non-lead metals, metalloids, non-metals (herein "metals or metallics") are those which are combustible and which having high heating value, exceeding 2,000 to 6,000, 6,500, 7,000, 7,500, 8,000, 8,500, 9,000, 9,500, 10,000, 10,500, 11,000, 12,000, or more, Kcal/kg, and which contain at least one element selected from the group consisting of aluminum, boron, bromine, bismuth, beryllium, calcium, cesium, chromium, cobalt, copper, francium, gallium, germanium, iodine, iron, indium, lithium, magnesium, manganese, molybdenum, nickel, niobium, phosphorus, potassium, palladium, rubidium, sodium, tin, zinc, praseodymium, rhenium, silicon, vanadium, strontium, barium, radium, scandium, yttrium, lanthanum, actinium, cerium, thorium, titanium, zirconium, hafnium, praseodymium, protactinium, tantalum, neodymium, uranium, tungsten, promethium, neptunium, samarium, plutonium, ruthenium, osmium, europium, americium, rhodium, iridium, gadolinium, curium, platinum, terbium, berkelium, silver, gold, dysprosiutn, californium, cadmium, mercury, holmium, titanium, erbium, thulium, arsenic, antimony, ytterbium, selenium, tellurium, polonium, lutetium, astatine, mixture thereof, including organic and inorganic derivatives thereof (as set forth in more detail below).

The preferred metals herein have oxides whose heats of formation are negative, and should be equal or exceed (e.g. be more negative) about -10,000 to -75,000 calories/mole. More preferred are those equal or exceeding -100,000 to -400,000 gr calories/mole, and greater (more negative). Simple oxides containing one or two oxygens may have heats of formation equal or exceeding -50,000 to -200,000, or greater, calories/mole are acceptable.

VAPOR PHASE COMBUSTION

This invention contemplates a vapor phase form/method of combusting a metallic, wherein said method comprises: introducing kinetic free radicals having enhanced combustion structure (ECS) into a combustion chamber; igniting and combusting a flammable metallic or metal compound in presence of said free radicals at temperature below said metal's oxide boiling point and preferably above said metal or metallic compound's boiling point; combusting said metal wherein accelerated burning occurs, as evidenced by a brilliant luminous reaction zone extending some distance from the metal's surface; wherein metallic oxide particles resulting from combustion are in submicron range and/or remain in a gaseous state.

The composition's ingredients and proportions are tailored to accomplish this objective. Varying compositions and ingredients will necessarily yield differing results. However, in the claims below providing for vapor phase combustion, the ingredients and ranges are at a minimum optimized/arranged to achieve this result.

NON-TOXIC ECS METALS

It is an object of this invention to eliminate neurotoxic manganese or other hazardous metal oxides of combustion, including concentrations thereof deemed to be toxic. It is a principal object of this invention to use metals and metal combinations, whose combustion product, oxides, carbonates, etc., are relatively non-toxic and absent neurotocity.

However, it is expressly recognized differing metals, and metallic blends yield different combustion products. Differing ECS metallic applications will results in different combustion products. In some applications and compositions the metal combustion products generated may be toxic. Yet in other compositions, and/or applications, the same metallic or metallics may elicit essentially non-toxic combustion products.

Thus, it is expressly contemplated differing applications

of the same metal, or differing metals acting together in combustion may produce non-toxic combustion products, while in other circumstances would produce toxic combustion products.

It is contemplated certain risk metals generating potentially toxic combustion products may be employed in applications where risk is acceptable, e.g. advanced jet, rocket, or outer space applications. Thus, metallics hazardous on earth could be employed in space.

It is also contemplated manganese containing metallic may be included in small concentrations in a mixture with non-manganese metallics. For example, methylcyclopentadienylmanganese tricarbonyl may be added in small concentrations, perhaps as an anti-knock enhancer in the case of gasoline. It may be included in other fuels as well.

In the practice of this invention alkali/alkali earth metals, whose metal oxides are non-toxic are preferred. Particularly preferred metals include lithium, sodium, potassium, rubidium, cesium, magnesium, and calcium. More preferred are lithium, sodium, potassium and magnesium.

Other non-lead, non-manganese metals, whose combustion product is moderately to relatively non-toxic, and desireable in the practice of this invention, include: aluminum, boron,

bismuth, cerium, gallium, lithium, potassium, sodium, phosphorus, sodium, magnesium, sulfur, chlorine, indium, iron, copper, zinc, silicon, iodine, cobalt, molybdenum, nitrogen, praseodymium, rhenium, rubidium, fluorine, tin, titanium, chromium, selenium, vanadium, boron, nickel, niobium, germanium, ytterbium, yttrium, zirconium. Blends of these metals, including their derivative compounds are contemplated.

However, slightly more desirable metals include: aluminum, boron, bismuth, calcium, cerium, cesium, gallium, lithium, potassium, sodium, magnesium, iron, copper, zinc, silicon, indium, molybdenum, nitrogen, potassium, praseodymium, rhenium, rubidium, tin, titanium, selenium, boron, germanium, ytterbium, yttrium, zirconium.

Even more desirable are aluminum, lithium, potassium, sodium, boron, potassium, magnesium, silicon, nitrogen, selenium, boron, and germanium.

It is an embodiment of this invention to substitute Applicant's non-toxic metallics for Mn in the aforementioned PCT Applications.

TESTS

Applicant conducted a series of horse power (HP) tests employing an air cooled honda 75 cc, four stroke engine, rated

at 2 horse power on a DYNOJET MODEL 100 DYNAMOMETER and found increases in HP above the engine's rate HP for certain compositions. Increased HP is an indication that the fuel would also show improvements in emissions, fuel economy, thrust, flight range, and the like, if measured. For purpose of this test only HP was measured. Certain test fuels required blending agents.

The tests were conducted to show changes in rated horse power due only to changes in fuel composition. For purpose of the test the bike's gasoline tank was disconnected. Tests measurements were performed after the engine had been warmed up. After each test fuel, the carburetor was drained of excess fuel and flushed to avoid fuel contamination.

After warm up, the test procedure included bringing the warmed bike to a stop (while engine operating), then shifting the bike into first gear and engaging the transmission and rear wheel on the dynamometer, with operator upon the bike. After shifting into second gear, the dynamometer was activated and the throttle was immediately opened to "wide open." The bike operated under full throttle until it reached a speed of about 30 mph (in second gear), when the test was terminated. Below are example fuels where improvement is indicated.

1. Base gasoline with 0.00156% vol methoxy-methylsilane

8. Base gasoline with 0.03125% vol trimethoxy-methylsilane

9. Base gasoline with 0.125% vol trimethoxy-methylsilane

10 Base gasoline with 0.25% vol trimethoxy-methylsilane

11 Base gasoline with 0.03125% vol trimethoxy-methylsilane, 2.5% O2 wt DMC

12 Base gasoline with 0.03125% vol trimethoxy-methylsilane, 3.5% 02 wt Ethanol

13 Base gasoline with 0.00156% vol dimethyl-phosphite

14 Base gasoline with 0.003125% vol dimethyl-phosphite

15 Base gasoline with 0.03125% vol dimethyl-phosphite

16 Base gasoline with 0.125% vol dimethyl-phosphite

17 Base gasoline with 0.25% vol dimethyl-

phosphite

18 Base gasoline with 0.003125% vol dimethyl-phosphite, 2.7% O2 wt MTBE

19 Base gasoline with 0.03125% vol dimethyl-phosphite, 2.5% O2 wt DMC

20 Base gasoline with 0.0.03125% wt potassium ethoxide

21 Base gasoline with 0.0625% wt potassium ethoxide

22 Base gasoline with 0.125% wt potassium ethoxide

23 Base gasoline with 0.0625% wt potassium ethoxide, 2.7 vol% MTBE

24 Base gasoline with 0.0625% wt potassium ethoxide, 2.5 vol% DMC

25 Base gasoline with 0.03125% wt potassium ethoxide, 2.7% O2 wt MTBE

26 Base gasoline with 0.0625% wt potassium ethoxide, 2.7% 02 wt MTBE

27 Base gasoline with 0.125% wt potassium ethoxide, 2.5% O2 wt DMC

28 Base gasoline with 0.003125% volume [2-(cyclohexenyl)

ethyl]triethoxysilane

29 Base gasoline with 0.03125% volume [2-(cyclohexenyl) ethyl]triethoxysilane

30 Base gasoline with 0.125% volume [2-(cyclohexenyl) ethyl]triethoxysilane

31 Base gasoline with 0.0625% volume [2-(cyclohexenyl) ethyl]triethoxysilane, 2.7% 02 wt MTBE

32 Base gasoline with 0.125% volume [2-(cyclohexenyl) ethyl]triethoxysilane,

2.5% O2 wt DMC

33 Base gasoline with 0.125% volume [2-(cyclohexenyl) ethyl]triethoxysilane,

3.5% O2 wt Ethanol

34 Base gasoline with 0.003125% volume [2-(cyclohexenyl) ethyl]triethoxysilane, 0.003125 vol% trimethoxymethylsilane

35 Base gasoline with 0.03125% volume [2-(cyclohexenyl) ethyl]triethoxysilane, 0.03125vol% trimethoxymethylsilane

36 Base gasoline with 0.0625% volume [2-(cyclohexenyl) ethyl]triethoxysilane, 0.03125vol% trimethoxymethylsilane

37 Base gasoline with 0.003125% volume [2-(cyclohexenyl) ethyl]triethoxysilane, 0.003125 vol% dimethylphosphite

38 Base gasoline with 0.03125% volume [2 -(cyclohexenyl) ethyl]triethoxysilane, 0.25 vol% trimethoxymethylsilane, 2.7% O2 wt MTBE

39 Base gasoline with 0.25% volume [2-(cyclohexenyl) ethyl]triethoxysilane, 0.25 vol% dimethylphosphite, 2.5% 02 wt DMC

Base gasoline with 0.00625% volume hexamethyldisilane

Base gasoline with 0.0625% volume hexamethyldisilane

40 Base gasoline with 0.0625% wt potassium ethoxide, 0.03125vol% trimethoxy methylsilane, 2.5% 02 wt DMC

43 Base gasoline with 0.0625% wt potassium ethoxide, 0.03125 vol%,trimethoxy methylsilane, 3.5% 02 .wt Ethanol

44 Base gasoline with 0.03125% wt potassium ethoxide, 0.0625 vol% trimethoxy methylsilane, 2.0% 02 wt MTBE

45 Base gasoline with 0.03125% wt potassium ethoxide,, 0.003125vol% dimethylphosphite, 2.5% 02 wt DMC

46 Base gasoline with 0.003125% wt potassium ethoxide, 0.0625vol% dimethyl phosphite, 3.5% O2 wt Ethanol

47 Base gasoline with 0.125% wt potassium ethoxide,

0.0625vol% dimethylphosphite, 2.2% O2 wt MTBE

48 Base gasoline with 0.03125% wt potassium phenoxide, 0.03125vol% dimethyl phosphite, 2.2% O2 wt MTBE

49 Base gasoline 0.03125% wt potassium tert-butoxide, 0.003125vol% dimethyl phosphite, 1.5% O2 wt MTBE

Applicant's has found a synergism of Applicant's ingredients and compositions. Synergisms appear to exist between trimethoxymethylsilane, base fuels, base fuels with DMC. Ethanol, and MTBE. Show similar results exist with dimethylphosphite. Like trimethoxymethylsilane, [2-(cyclohexenyl)ethyl]triethoxysilane, hexamethyldisilane, potassium ethoxide, potassium phenoxide, and dimethylphosphite show improvement in hydrocarbon bases alone, but better improvement when present with ECS compounds MTBE, DMC and Ethanol, and still better improvement when either dimethylphosphite and trimethoxymethylsilane are used with the other metallics, such as MMT.

Trimethoxymethylsilane and dimethoxyphosphite appear interchangeable in certain applications.

PRACTICE

Example 1

A non-toxic vapor phase combustion composition comprising:

1) an ECS oxygenate (preferably selected from a hydrocarbyl ether, an alcohol, carbonate, or methylal/ethylal), 2) an ECS metallic, preferably a non-neurotoxic ECS alkali/alkali earth metallic derivative (preferably an.alkyloxide of potassium or a potassium ferricyanide), or a derivative of lithium, boron, silicon, or aluminum, optionally; 3) a hydrocarbon, and/or optionally a 4) a co-combustion catalyst (preferably a silicon alkyloxy derivative, like trimethoxymethylsilane, or an alkyl/dialkyl phosphite like dimethylphosphite.

Example 2

The above examples, wherein the composition constructed to have a pH ranging from 3.0 to 12.0, 3.5 to 11.5, 4.0 to 11.0, 4.5 to 11.5, more preferably 5.5 to 9.5, even more preferably 6.5 to 6.9.

Example 3

The above examples, wherein the ECS metallic is an alkali/alkali earth metal (a non-limiting example, potassium ethoxide) and the co-combustion agent is a phosphorus derivative (non-limiting example dimethyl or diethyl phosphite), wherein the composition .has a pH equal or less than 10.5, 9.5, 8.5, 7.5, but greater than 4.5, 5.5, or 6.0, (substantially neutral is preferred).

Example 4

The above Examples, wherein the ECS metallic is selected from alkyl metal and alkyl earth metal salts, naptha's, ferricyanides, organo-metallics (optionally containing oxygen and/or nitrogen) and derivative compound, including potassium alkanols, potassium alkyl oxides, e.g. potassium methoxide, potassium ethoxide, potassium propoxide, potassium isopropoxide, potassium butoxide, potassium sec-butoxide, potassium tert-butoxide, potassium pentoxide, potassium tert-pentoxide, potassium phenoxide, etc. Other non-limiting examples of potassium salts include potassium hydrogenphthalate, potassium hydrogensulfate, monopotassium acetylenedicarboxylic acid, potassium pyrophosphate, potassium dihydrogenphosphate, potassium benzoate, potassium chloride, potassium hexoate (potassium salt hexoic acid), potassium acetates, potassium formates, potassium diphenylphosphide, potassium trimethylsilonalate, potassium phthalic acid, P-aminobenzoic acid potassium salt, monopotassium L-aspartic acid, potassium napthenate. Corresponding sodium, lithium, rubidium, cesium compounds are contemplated. Mixtures are contemplated.

Example 4A

The above examples, wherein said ECS metallic is selected from potassium ethoxide, potassium tert-butoxide, potassium phenoxide, potassium acetate, potassium napthenate and mixture.

Example 4B

The above examples, wherein said fuel contains a TMMS co-combustion catalyst.

Example 4B

The above examples, wherein said fuel contains stabilizer selected from TMMS, toluene, glycols, glycol ethers and mixture.

Example 4C

The above examples, wherein the ECS component is oxygenated, selected from C2 - C12 aldehydes (including aldehydic acids), C2 -G12 ethers (including ether acids), C3 to C15 di-ethers, Cl -C15 alcohols, C2 - C12 oxides, C3 -C15 ketones, ketonic acids, C3 - C15 esters (alkyl formates, acetates, diacetates, butyrates, etc.), othroesters, C3 -C12 diesters, C5 -C12 phenols, C3 - C20 glycol ethers, C2 -C12 glycols, C3 - C20 alkyl carbonates, C3 - C20 dialkyl carbonates, C3 - C20 asymmetrical alkyl/dialkyl carbonates, C3 - C20

di-carbonates, Cl to C20 organic and inorganic peroxides, hydroperoxides, carboxylic acids (including formic acids), amines, nitrates, di-nitrates, oxalates, phenols, glacial acetic acids (including C3 to C8 hyrodoxy esters of acetic acid, anhydrides, methoxy methyl ester of acetic acid, etc.), boric acids, orthoborates, hydroxyacids, orthoacids, anhydrides, acetate's, acetyls, nitrates, di-nitrates, nitro-ethers, homologues, analogue, derivative and mixture.

Example 5

The above Examples, wherein the ECS metallic is selected from a silicon derivative including: [2-(cyclohexenyl)ethyl]triethoxysilane, cyclohexenyl dimethoxymethylsilane, benzyltrimethylsilane, N-(3-(trimethoxysilyl)propyl)ethylene-diamine, N-1-(3-(trimethoxysilyl)-propyl)diethylenetriamine, N-(3(trimethoxysilyl)propyl)-ethylenediamine, 1-(trimethyl(silyl)-pyrrolidine, triphenylsilanol, octamethyltrisiloxane, 2,2,4,4,6,6-hexamethylcyclotrisilazane, hexamethylcyctrisiloxane, hexamethyl-disilane, 1,1,1,3,3,3-hexamethyl disilazane, hexamethyldisiloxane, hexamethyldisilthiane, allyltributylsilane, tetraalkylsilanes (e.g.

tetraethylsilane, tetrabutylsilane, etc.), 3-aminopropyltriethoxy-silane, benzytrimethylsilane, benzytriethylsilane, N-benzyltri-methylsilylamine, diphenylsilanediol, dihexylsilanediol, (trimethyl-silyl)cyclopentadiene, including homologues, analogues and derivative thereof.

<u>Example 5A</u>

A fuel composition containing an ECS oxygenate increasing burning velocity and/or reducing combustion temperature, optionally selected from MTBE, ETBE, DMC, DEC, methylal, ethylal, methanol, ethanol, or mixture, and an ECS metal selected from methylcyclopentadienylmanganese tricarbonyl, ,[2- (cyclbhexenyl) ethyl] triethoxysilane, cyclohexenyl /dimethoxymethylsilane, benzyltrimethylsilane, N-(3-(trimethoxysilyl)propyl) ethylenediamine, N-1-(3-(trimethoxysilyl)propyl) diethylenetriamine,N-(3-(trimethoxysilyl)propyl)ethylenediamine, 1-(trimethyl(silyl-) pyrrolidine, triphenyl»silanol, octamethyltrisiloxane, 2,2,4,4,6,6-hexamethylcyclotrisilazane, hexamethylcyctrisiloxane, hexamethyldisilane, 1,1,3,3,3-hexamethyl disilazane, hexamethyldisiloxane,

hexamethyldisilthiane, allyltributylsilane, tetraalkylsilanes (e.g. tetraethylsilane, tetrabutylsilane, etc.), 3-aminopropyltriethoxysilane, benzytrimethylsilane, benzytriethylsilane, N-benzyltrimethylsilylamine, diphenyl-silanediol, dihexylsilanediol, (trimethylsilyl)cyclopentadiene, potassium methoxide, potassium ethoxide, potassium propoxide, potassium isopropoxide, potassium butoxide, potassium sec-butoxide, potassium tert-butoxide, potassium pentoxide, potassium tert-pentoxide, potassium phenoxide, potassium salt of acetic acid, potassium hydrogenpht'halate, potassium hydrogensulfate, monopotassium acetylenedicarboxylic acid, potassium pyrophosphate, potassium dihydrogenphosphate, potassium benzoate, potassium chloride, potassium hexoate (potassium salt hexoic acid), potassium acetate, potassium diphenylphosphide, potassium trimethylsilonalate, potassium phthalic acid, P-aminobenzoic acid potassium salt, monopotassium L-aspartic acid, potassium napthenate, potassium hexacyanoferrate (II), potassium hexacyanoferrate (III), potassium hexacyanocobalt II- ferrate, potassium hexacyanocobalt, potassium sodium ferricyanide, or mixture.

EXAMPLE 6

The above examples, wherein the ECS metallic is selected from a spiral compound based upon ferricyanhydric acid derivatives, namely ferricyanides. See Dictionary of Chemical Solubilties, supra, pages 334-342, which lists various ferrocyanides (as herein provided ferrocyanides include cyanoferrates, ferricyanides, and the like), incorporated herein by reference. Alkali and alkali earth metal ferrocyanides are desireable. Transition metal ferrocyanides are desireable. Nitrogen ferrocyanides are desireable. Non-limiting examples include: potassium hexacyanoferrate (II) and potassium hexacyanoferrate (III) are desireable. Non-limiting examples include potassium hexacyanocobalt II-ferrate, potassium Hexacyanocobalt III, potassium hexachloroosmate (IV), potassium hexachloroplatinate (IV), potassium hexafluorosilicate, potassium hexafluoromanganate (IV), potassium Hexaflourozirconate. potassium hexathiocyanatoplatinate (IV), potassium sodium ferricyanide, potassium hexacyanoplatinate, potassium hexacyanoruthinate (Il)hydrate, potassium hexacyanoplatinate (IV), potassium hexafluoroaluminate, potassium hexafluoroarsenate, potassium hexafluorophosphite, potassium hexafluorophosphite, potassium hexafluorosilicate, potassium hexahydroxyantimonate,

potassium hexafluoro titante, Potassium copper ferracyanide, potassium cyanide, iron (III) ferrocyanide, sodium ferrocyanide decahydrate, magnesium ferrocyanide, magnesium potassium ferrocyanide. Naturally other cyano-spiral, including hexacyano compounds are contemplated. Substitutions for potassium and/or iron are also contemplated. Examples of such substitution include potassium hexacyanocobaltate (III), sodium hexacyanocobaltate (III), etc. Structurally similar compounds, analogues, and homologues, etc., are incorporated herein by reference and contemplated.

Example 6a

The example of 5, 5A, 6, wherein said composition contains a solvent is selected from alkyl ketones (acetone, etc.), alkyl alcohols (methanol, ethanol, isobutanol), alkyl ethers, glycerols, alkanol amines (ethanolamine, etc.), and other solvent known in the art and soluble with said hexacyanides (herein incorporated by reference), Applicant's ECS oxygenates, and optionally with a hydrocarbon (incorporated herein by refer-ence). or other known solvent is employed capable of creating a solution, which is soluble in ECS oxygenate and/or a hydrocarbon base.

Example 6b

The example of 6 and 6a, containing an ECS oxygenate in a combustion improving amount, and

II) a combustion improving amount of a ferricyanide; and optionally: III) a co-combustion catalyst, IV) hydrogen or a hydrocarbon base fuel, V) an oxidizer, VI) a solvent;

wherein said composition is optionally VII) characterized as having a pH of from 4.5 to 10.5; and

VIII) wherein said fuel is a vapor phase composition characterized upon combustion as having a luminous reaction zone extending from surface of said element.

Example 6c

The example 6, 6a and,6b, wherein the ECS oxygenate is selected from the group consisting of MTBE, ETBE, TAME, ethanol, methanol, DMC, EMC or mixture; the ferricyanide is optionally, a potassium based; the composition comprises a hydrocarbon base; and the composition optionally contains a mutual solvent.

Example 6D

A fuel composition containing an NLEC (MMT) and a compound selected from triemethoxymethylsilane, dimethylphosphite, ethoxytrimethylsilane,,isobutyltriethoxy-silane,

tetramethylsilane; dimethoxy-methyl-vinyl-silane, methyltriethoxysilane, 3-aminopropyl-triethoxysilane, 3-aminopropyl-trimethoxysilane, vinyltrimethoxysilane, diethoxydi-methylsilane, dimethoxydimethylsilane, vinyltris(2-butyldenamino-oxy)silane,'tetraalkyloxysilanes, tetramethoxysilane, tetraethoxysilane, tetrapropyloxysilane, tetraisopropylsilane, tetraisobutylsilane, a dialkylphosphites, dimethyl-phosphite, diethylphosphite, dipropylphosphite, dibutylphosphite, di-tert-butylphosphite, trialkylphosphites, trimethylphosphite, triethylphosphite, tripropylphosphite, triisopropylphosphite, tributyl-phosphite), dimethylmethylphos-phonate, diethylmethyl-phos-phonate, P-pyrophosphate, trimethyl-orthoacetate, trimethylorthovalerate, trimethylorthobutyrate, trimethylortho-formate, aIkyloxymethanes, tetraalkyloxymethanes, tetramethoxymethane, tetraethoxymethane, tetrapropoxymethane, tetraisopropoxy-methane, tetratert-butoxy-methane, potassium pryophosphite, trimethylorthoacetate, triethylorthoacetate, trimethylorthobutyrate, triethylortho-butyrate, trimethylorthovalerate, trimethylorthoformate, dimethoxymethane, diethoxyethane, tetramethoxymethane,

triethoxymethylmethane, tri-methoxymethylmethane, tetraethoxymethane, trimethoxymethylethane, triethoxymethylethane, glacial acetic acid, acetic acide anhydride, (acetyloxy) acid acid, ethyl ester (acetyloxy) acetic acid, aminooxo acetic acid, aminooxo acetic acid hydrazide, ammonium acetate, acetoacetic acid, methoxyacetic acid, ethoxyacetic acid, methoxy ethyl ester of acetic acid, methoxy methyl ester of acetic acid, ethoxy methyl ester of acetic acid, ethoxy ethyl ester of acetic acid, propoxy methyl ester of acetic acid, oxoacetic acid, an alkylhydroxyesters of acetic acid, methylesterhydro-xyacetic acid, ethylesterhydroxy-acetic acid, propylesterhydro-xyacetic acid, alkyl acetates, methyl ester acetic acid, ethyl arsenate, ethyl arsenite, methyl ester of butanic acid, ethyl ester of butanic acid, 2-hydroxybutanic acid, 3-hydroxybutanic acid, 3-hydroxy-ethylester of butanic acid, 2-hydroxyethylester of butanic acid, diphenyl carbonate, dipropyl carbonate, ethylmethyl carbonate, dibutyl carbonate, tetranitromethane, triethylphosphine oxide, triethylphosphine oxide, triethylphosphine, diethyl-phosphinic acid, dimethylphosphinic acid, ethyl diethylphosphinic acid, diethylphosphonic chloride, dibutyl ester phosphonic acid, (1,

1-dimethylethyl) phosphonic acid, ethenyl diethyl ester phosphoric acid, diethyl ethylphosphonate, ethyl dimethylester phosphonic acid, methyl dimethylester phosphonic acid, methyl monoethylester phosphonic acid, methyl monomethylester phosphonic acid, methyl-0,0-dimethylester phosphonothioic acid, diethyl ester phosphoric acid, dimethyl ester phosphoric acid, tributyl phosphate, ethylphosphate, trimethyl ester ester phosphoric acid, triethyl ester ester phosphoric acid, tripropyl phosphate, O,O,O,-triethyl ester phosphorothioic acid, diethylester phosphorous acid, dimethylester phosphorous acid, tributyl ester pho'sphorous acid, triphenyl ester phosphorous acid, 0,O,S-tiethyl ester phosphorodithioic acid, 2-methyl-1, 2,propanediol, 2-methyl-2-nitro-1,3,-propanediol, 2-methyl-2-propyl-1,3,-propanediol,
1-nitrate-1,2,propanediol,
1,1',1",1'"-[methanetetrayltetrakis(oxy)]-tetrakis propane, methyl propyl ether, isopropylmethyl ether, isobutyl methyl ether, ethyl propyl ether, propylmethyl ether, butyl methyl ether, 1,1'-[methylenebis(oxy)]bis[2-methyl-propane,
1-(1-methylethoxy)-propane,
2,2' ,2"-[methylidyne-tris(oxy)]tris propane,
1,1',1"-[methylidynetris(oxy)]tris[2-methyl propane,

2-methyl-1-nitro propane, 2-methyl-2-nitro propane, hydracrylonitrile, 1,1,1-triethoxy-propane, 1,3-triethoxy-propane, 1,1,1-trimethoxy-propane, 1,1,3-trimethoxy-propane, 1,1,1-trifluoro-3-nitro-propane, 2-pyrrolidinone, phenol, and mixture.

The above example where MMMT is combined with a combustion catalyst selected from group consisting of trimethoxymethylsilane, ethoxytrimethylsilane, isobutyltriethoxysilane, tetramethylsilane, dimethoxy-methyl-vinyl-silane, methyltriethoxysilane, 3-aminopropyl-triethoxysilane, 3-aminopropyl-trimethoxysilane, vinyltrimethoxysilane, diethoxydimethylsilane, di-methoxydimethylsilane, vinyltris(2-butyldenaminooxy)silane, tetramethoxysilane, tetraethoxysilane, tetrapropyloxysilane, tetraisopropylsilane, tetraisobutylsilane, dimethylphosphite, dipropylphosphite, diethylphosphite, dibutylphosphite, di-tert-butylphosphite(trialkylphosphites trimethylphosphite, triethylphosphite, triisopropylphosphite, tributylphosphite), dimethyl-methylpHosphonate, diethylmethylphosphonate, potassium pryo-phosphite, trimethylorthoacetate, triethylorthoacet.ate, tri-methylorthobutyrate,

triethylorthobutyrate, tri-methylorthovalerate, trimethylorthoformate, [2-(cyclohexenyl)ethyl]triethoxysilane, cyclohexenyl dimethoxymethylsilane, benzyltrimethylsilane, N-(3-(trimethoxysilyl)propyl)ethylenediamine, N-1-(3-(trimethoxysilyl)propyl) diethylenetriamine, N-(3-(trimethoxysilyl)propyl)ethylenediamine,1-(trimethyl(silyl-) pyrrolidine, triphenylsilanol, octamethyltrisiloxane, 2,2,4,4,6,6-hexamethylcyclotrisilazane, hexamethylcyctrisiloxane, hexamethyldisilane, 1,1,1,3,3,3-hexamethyl disilazane, hexamethyldisiloxane, hexamethyldisilthiane, allyltributylsilane, tetraalkylsilanes (e.g. tetraethylsilane, tetrabutylsilane, etc.), 3-aminopropyltriethoxysilane, benzytrimethylsilane, benzytriethylsilane, N-benzyltrimethylsilylamine, diphenyl-silanediol, dihexylsilanediol, (trimethylsilyl)cyclopentadiene, potassium methoxide, potassium ethoxide, potassium propoxide, potassium isopropoxide, potassium butoxide, potassium sec-butoxide, potassium tert-butoxide, potassium pentoxide, potassium tert-pentoxide, potassium phenoxide, potassium salt of acetic acid, potassium hydrogenphthalate, potassium hydrogensulfate,

monopotassium acetylenedicarboxylic acid, potassium pyrophosphate, potassium dihydrogenphosphate, potassium benzoate, potassium chloride, potassium hexoate (potassium salt hexoic acid), potassium acetate, potassium diphenylphosphide, potassium trimethylsilonalate, potassium phthalic acid, P-aminobenzoic acid potassium salt, monopotassium L-aspartic acid, potassium napthenate, potassium hexacyanoferrate (II), potassium hexacyanoferrate (III), potassium hexacyanocobalt II- ferrate, potassium hexacyanocobalt, potassium sodium ferricyanide, or mixture.

Example 7

The example of 6, wherein said hexacyanide is preferably potassium hexacyanoferrate (II) or (III), and optionally contains a mutual solvent, optionally containing a co-combustion catalyst.

EXAMPLE 8

The Examples above, wherein the ECS oxygenated is methyl tertiary butyl ethers (MTBE), ethyl tertiary butyl ether (ETBE), tertiary methyl amyl ether (TAME), tertiary methyl ethyl ether (TEME), ethyl tertiary amyl ether; Cl to C6 aliphatic alcohols, including but not limited to ethanol,, methanol; lower diakyl carbonates, including but not limited to dimethyl carbonate

(DMC), diethyl carbonate (DEC); ethers having dual linkage, including but not limited to methyal (methylene di methyl ether or dimethoxy methane), ethylal (diethoxy methane); carbons having multiple alkyloxy groups, including but not limited to tetramethoxymethane, anhydrides and hyrodoxy esters of acetic acid, including but not limited to methoxy methyl ester of acetic acid, ethoxy methyl ester of acetic acid.

Example 9

A fuel composition comprising: I) an ECS oxygenate in a combustion improving amount, and

II) a combustion improving, amount of at least one combustible element or compound containing at least one element selected from the group consisting of aluminum, boron, bromine, bismuth, beryllium, calcium, cesium, chromium, cobalt, copper, francium,. gallium, germanium, iodine, iron, indium, lithium, magnesium, manganese, molybdenum, nickel, niobium, phosphorus, potassium, palladium, rubidium, sodium, tin, zinc, praseodymium, rhenium, silicon, vanadium, strontium, barium, radium, scandium, yttrium, lanthanum, actinium, cerium, thorium, titanium, zirconium, hafnium, praseodymium, protactinium, tantalum, neodymium, uranium, tungsten, promethium,

neptunium, samarium, plutonium, ruthenium, osmium, europium, americium, rhodium, iridium, gadolinium, curium, platinum, terbium, berkelium, silver, gold, dysprosium, californium, cadmium, mercury, holmium, titanium, erbium, thulium, arsenic, antimony, ytterbium, selenium, tellurium, polonium, lutetium, astatine, mixture thereof, including organic and inorganic derivatives, and

III) a co-combustion catalyst, and

IV) optionally hydrogen or a hydrocarbon base fuel, and

V) optionally an oxidizer, and

VI) optionally wherein said fuel composition has a pH of from 4.5 to 10.5, and

VII) wherein said fuel is a vapor phase composition characterized upon combustion as having a luminous reaction zone extending from surface of said element.

Example 10

The fuel of Example 9, wherein the ECS oxygenate is selected from the group consisting of methyl tertiary butyl ethers, ethyl tertiary butyl ether, tertiary methyl amyl ether, tertiary methyl ethyl ether, ethyl tertiary amyl ether, Cl to C6 aliphatic alcohols, dimethyl carbonate, diethyl carbonate,

and mixture.

CO-COMBUSTION AGENT/CATALYST

As evident in the tests above, it has been found the combustion activity employing Applicant's ECS oxygenated compounds and metallics is unexpectedly improved by the combination of a co-combustion catalyst, such as trimethoxymethylsilane or dimethyl-phosphite.

As contemplated in the claims hereto, co-combustion agents may serve a multiple role, including acting as a stabilizing agents. As set forth in greater detail below TMMS and other co-catalysts acts in combination with certain beneficial components to stabilize the fuel composition. Thus, as set forth herein a co-combustion catalyst can serve as a stabilizing agent.

The co-combustion catalyst (combustion co-catalyst) is a combustible compound generally having a structure of $M\text{-}r_n$, wherein M is a metal, metalloid, or non-metal. Selected M include, but are not limited to, carbon, silicon, germanium, tin, boron, aluminum, gallium, indium, nitrogen, phosphorus, arsenic, antinomy, bismuth, sulfur, and wherein r is either an alkyloxy, hydroxy, oxy, or carboxyl radical, and wherein n is the number up to the number of valence electrons of M or the

total possible number of radicals available.

If n is greater than one, then r1, r2, etc., may be a heterogeneous or homogenous, an alkyloxy, nitro, or other radical, including an alkyl or aryl radical. If n is greater than 1, one or more r may be alkyl or cyclomatic radicals may be substituted. However, compounds with at least one alkyloxy, hydroxy, oxy, or carboxyl radical are desired. Compounds containing a blend of alkyl or alkyloxy, hydroxy, oxy, carboxyl radicals are contemplated. Thus, alkyloxymetallics and polyalkyloxymetallics are expressly contemplated.

If r is greater than one, then one or more r may be substituted for direct or indirectly connected ring systems, for example r1 may be a phenyl radical connected directly, or indirectly connected through an alkyl group to M, where r2, r3, etc., may be an alkyloxy or alkyl radical. Likewise, when more than one r may be substituted for sulfur, nitrogen, chlorine, fluorine, or other metal, metalloid or non-metal of this invention.

Preferred co-combustion catalysts have one or more

alkyloxy, carboxyl, oxy, or hydroxy radicals. More preferred catalysts have one or more alkyloxy, oxy, carboxyl, hydroxy, radicals, and at least one alkyl radical. A ring system radical may be substituted for the alkyl radical.

Non-limiting examples of co-combustion catalyst, including derivative, analogue, homologue and isomers thereof, include polyalkyloxysilaries: trimethoxymethylsilane, ethoxytrimethylsilane, isobutyltriethoxy-silane, tetramethylsilane, dimethoxy-methyl-vinyl-silane, methyltriethoxysilane, 3-aminopropyl-triethoxysilane, 3-aminopropyl-trimethoxysilane, vinyltrimethoxysilane, diethoxydi-methylsilane, dimethoxydimethylsilane, vinyltris(2-butyldenamino-oxy)silane, tetraalkyloxysilanes (e.g. tetramethoxysilane, tetraethoxysilane, tetrapropyloxysilane, tetraisopropylsilane, tetraisobutylsilane, etc.); alkylphosphites, polyalkylphosphites (e.g. dimethyl-phosphite, diethylphosphite, dipropylphosphite, dibutylphosphite, di-tert-butylphosphite, trimethylphosphite, triethylphosphite, tripropylphosphite, triisopropylphosphite, tributylphosphite), dimethylmethylphos-phonate, diethylmethylphosphonate, P-pyrophosphate,

alkylphosphoramides, polyalkylphosphoramides e.g. hexamethylphosphoramide, hexamethylphosphorus diamide, hexamethylphosphorus triamide, hexamethylphospophorimidic triamide, triethylphosphoramide, trimethylphosphoramide, tripropylphosphoramide, triisopropylphosphoramide, tributylphosphoramide, tri-isobutylphosphoramide, tri-sec-butylphosphoramide, tri-tert-butylphosphoramide, triphenylphosphoramide, dimethoxyphosphorusamide (CH3O)2PNH2), diethoxyphosphorusamide, dipropoxyphosphorusamide, diisopropoxyphosphorusamide, dibutoxyphosphorusamide, di-isobutoxyphosphorusamide, di-sec-butoxyphosphorusamide, di-tert-butoxyphosphorusamide, diphenoxyphosphorusamide, dimethylphosphoramide (CH3O)2PONH2), diethylphosphoramide, dipropylphosphoramide, diisopropylphosphoramide, dibutyl-phospnoramide, diisobutylphosphoramide, di-sec-butylphosphoramide, di-tert-butylphosphoramide, diphenylphosphoramide, dimethylethylphosphoramide, diethylmethylphosphoramide, dipropylmethylphosphoramide, diisopropyImethylphosphoramide, di-butyl-methyl-phosphoramide, di-iso-butylmethylphosphoramide, di-sec-butylmethylphosphoramide,

di-tert-butylmethylphosphoramide, diphenylmethyl phosphoramide), trimethyl-orthoacetate, trimethylorthovalerate, trimethylorthobutyrate, trimethylorthoformate; aIkyloxymethanes (tetramethoxy-methane, tetraethoxymethane, tetrapropoxymethane, tetraisopropoxy-methane, tetratertbutoxy-methane, etc.), polyalkyloxymethanes; potassium pryophosphite, trimethylorthoacetate, triethylorthoacetate, trimethylorthobutyrate, triethylortho-butyrate, trimethylorthovalerate, trimethylorthoformate, dimethoxymethane, diethoxyethane, ,, tetramethbxymethane, tri-methoxymethylmethane, tetraethoxymethane, trimethoxymethylethane, triethoxymethylethane, trimethoxymethylmethane, triethoxy-methylmethane, glacial acetic acids, including but not limited to acetic anhydrides, (acetyloxy) acid, ethyl ester acetyloxy) acetic acid, aminooxo acetic acid, aminooxo acetic acid hydrazide, ammonium acetate, acetoacetic acid, hydroxyacetic acid glycolic acid), methoxyacetic acid, ethoxyacetic acid, methoxy ethyl ester of acetic acid, methoxy methyl ester of acetic acid, ethoxy methyl ester of acetic acid, ethoxy ethyl ester of acetic acid, propoxy methyl ester of

acetic acid, oxoacetic acid, alkylhydroxyesters of acetic acid (including but not limited to methylesterhydro-xyacetic acid, ethylesterhydroxy-acetic acid, propylesterhydro-xyacetic acid, alkyl acetates including methyl ester acetic acid), ethyl arsenate, ethyl arsenite, methyl ester of butanic acid, ethyl ester of butanic acid, 2-hydroxybutanic acid, 3-hydroxybutanic acid, 3-hydroxy-ethylester of butanic acid, 2-hydroxyethylester of butanic acid, diphenyl carbonate, dipropyl carbonate, ethylmethyl carbonate, dibutyl carbonate, tetranitromethane, triethylphosphine oxide, triethylphosphine oxide, triethylphosphine, diethyl-phosphinic acid, dimethylphosphinic acid, ethyl diethylphosphinic acid,diethylphosphonic chloride, dibutyl ester phosphonic acid, (1, 1-dimethylethyl) phosphonic acid, ethenyl diethyl ester phosphoric acid, diethyl ethylphosphonate, ethyl dimethylester phosphonic acid, methyl dimethylester phosphonic acid, methyl monoethylester phosphonic acid, methyl monomethylester phosphonic acid, methyl-0,0-dimethylester phosphonothioic acid, diethyl ester phosphoric acid, dimethyl ester phosphoric acid, tributyl phosphate, ethylghosphate, trimethyl ester phosphoric acid, triethyl ester""phosphoric acid, tripropyl phosphate, 0,0,0,-triethyl ester phosphorothioic acid,

diethylester phosphorous acid, dimethylester phosphorous acid, tributyl ester phosphorous acid, triphenyl ester phosphorous acid,0,0,S-tiethyl ester phosphorodithioic acid, 2-methyl-1,2,propanediol, 2-methyl-2-nitro-1,3,-propanediol, 2-methyl-2-propyl-1,3,-propanediol, 1-nitrate-1,2,propanediol, 1',1',1"-[methanetetrayltetrakis(oxy)]-tetrakis propane, methyl propyl ether, isopropylmethyl ether, isobutyl methyl ether, ethyl propyl ether, propylmethyl ether, butyl methyl ether, tertiary butyl methyl ether, 1, 1'-[methylenebis(oxy)]bis[2-methyl-propane, 1-(1-methylethoxy)-propane, 2',2"-[methylidyne-tris(oxy)]tris propane, 1,1',1"-[methylidynetris(oxy)]tris[2-methyl propane, 2-methyl-1-nitro propane, 2-methyl-2-nitro propane, hydracrylonitrile, 1,1,1-triethoxy-propane, 1,1,3-triethoxy-propane, 1,1,1-trimethoxy-propane, 1,1,3-trimethoxy-propane, 1,1,1-trifluoro-3-nitro-propane, 2-pyrrolidinone, and phenol. Similar structured compounds of aluminum, gallium, germanium, nitrogen, and sulfur are contemplated and incorporated by reference.

It is to be appreciated not every possible combination of

this invention is available due to potential incompatibilities, and certain combinations are more effective than others. Thus, it is contemplated a wide range of substitution be made to best practice the invention. Where necessary mutual solvents are contemplated.

As contemplated herein and in the claims below, any reference to trimethoxymethylsilane ("TMMS") or dimethylphosphite or co-combustion catalyst contemplates substitution with one or more the above disclosed co-combustion catalysts, or any structurally similar compound. It is contemplated the majority of the Applicant's ECS metallics (including those disclosed herein), including contemplated cyclomatic metallics, alkali/alkali earth metals, metal alkanols, metallic hexacyanides, inorganic metallics and non-metals alike, which achieve vapor phase combustion on their own, can be benefited from simultaneous use of co-combustion agent. Thus, it is an embodiment of this invention, and the aforementioned PCT Applications, wherever an ECS metallic is disclosed, that a co-combustion agent be additionally added.

Example 11

A fuel composition comprising: 1) an ECS oxygenate, 2) a co-combustion catalyst, and optionally: 3) a hydrocarbon or 4)

an ECS metallic; said fuel optionally having a pH range of 10.5 to 4.0, 9.5 to 5.0,8.5 to 6.0, 8.0 to 6.3, 7.8 to 6.2, 7.6 to 6.2; or optionally a pH less than 10.5, 10.0, 9.5, 9.0, 8.5, 8.0, 7.9, 7.8, 7.7., 7.6, 7.5, 7.4, 7.3, 7.2, 7.0, 6.9, 6.8, but greater than a pH of 4.0, 4.5, 5.0, 5.5, 6.0, 6.2, or 6.5.

Example 11A

A fuel composition comprising: 1) a hydrocarbon, 2) a co-combustion catalyst, and optionally: 3) an ECS oxygenate, or 3) an ECS metallic; said fuel optionally having a pH range of 10.5 to 4.0, 9.5 to 5.0, 8.5 to 6.0, 8 . 0 to 6.3, 7.8 to 6.2, 7.6 to 6.2; or optionally a pH less than 10.5, 10.0, 9.5, 9.0, 8.5, 8.0, 7.9, 7.8, 7.7., 7.6, 7.5, 7.4, 7.3, 7.2, 7.0, 6.9, 6.8, but greater than a pH of 4.0, 4.5, 5.0, 5.5, 6.0, 6.2, or 6.5,

Example 11B

A fuel composition comprising: 1) an ECS metallic; 2) a co-combustion catalyst, and optionally: 3) a hydrocarbon, 4) an ECS oxygenate, said fuel optionally having a pH range of 10.5 to 4.0, 9.5 to 5.0, 8.5 to 6.0, 8.0 to 6.3, 7.8 to 6.2, 7.6 to 6.2; or optionally a pH less than 10.5, 10.0, 9.5, 9.0, 8.5, 8.0, 7.9, 7.8, 7.7., 7.6, .7-5, 7.4, 7.3, 7.2, 7.0, 6.9, 6.8, but greater than a pH of 4.0, 4.5, 5.0, 5.5, 6.0, 6.2, or 6.5,

Example 12

The composition of Example 11, 11A, 11B, wherein the a co-combustion catalyst is selected from group consisting of trimethoxymethylsilane, ethoxytrimethylsilane, isobutyltriethoxysilane, tetramethylsilane, dimethoxy-methyl-vinyl-silane, methyltriethoxysilane, 3-aminopropyl-triethoxysilane, 3-aminopropyl-trimethoxysilane, vinyltrimethoxysilane, diethoxydimethylsilane, dimethoxydimethylsilane, vinyltris(2-butyldenaminooxy)silane, tetramethoxysilane, tetraethoxysilane, tetrapropyloxysilane, tetraisopropylsilane, tetraisobutylsilane, dimethylphosphite, dipropylphosphite, diethylphosphite, dibutylphosphite, di-tert-butylphosphite, trialkylphosphites trimethylphosphite, triethylphosphite, triisopropylphosphite, tributylphosphite), dimethylmethylphosphonate, diethylmethylphosphonate, potassium pryophosphite, trimethylorthoacetate, triethylorthoacetate, trimethylorthobutyrate, triethylorthobutyrate, trimethylorthovalerate, trimethylorthoformate, including homolgues, analogues, isomers, derivatives, and mixture thereof.

Example 12

The fuel composition of Example 11, 11A, 11B, wherein the co-combustion catalyst is selected from group consisting of trimethoxymethylsilane, dimethylphosphite, diethyphosphite, tetramethoxymethane, tetraethoxymethane, trimethoxymethylmethane, triethoxymethylmethane, methoxy methyl ester of acetic acid, tetranitromethane, and mixture.

Example 13

The fuel composition of Example 11, 11A, 11B, wherein the ECS oxygenate is optionally selected from MTBE, ETBE, DMC, methanol, ethanol, methylal, or mixture, and the ECS metal is a combustible compound is selected from [2-(cyclohexenyl)ethyl]triethoxysilane, cyclohexenyl dimethoxymethylsilane, benzyltrimethylsilane, N-(3-(trimethoxysilyl)propyl)ethylenediamine, N-1-(3-(trimethoxysilyl)propyl)diethylenetriamine, N-(3-(trimethoxysilyl)propyl)ethylenediamine, 1-(trimethyl(silyl)pyrrolidine, triphenylsilanol, octamethyltrisiloxane, 2,2,4,4,6,6-hexamethylcyclotrisilazane, hexamethylcyctrisiloxane, hexamethyldisilane, 1,1,1,3,3,3-hexamethyl disilazane, hexamethyldisiloxane, hexamethyldisilthiane,

allyltributylsilane, tetraalkylsilanes (e.g. tetraethylsilane, tetrabutylsilane, etc.), 3-aminopropyltriethoxysilane, benzytrimethylsilane, benzytriethylsilane, N-benzyltrimethylsilylamine, diphenylsilanediol, dihexylsilanediol, (trimethylsilyl)cyclopentadiene, potassium methoxide, potassium ethoxide, potassium propoxide, potassium isopropoxide, potassium butoxide, potassium sec-butoxide, potassium.tert-butoxide, potassium pentoxide, potassium tert-pent6xide, potassium phenoxide, potassium salt, of acetic acid, potassium hydrogenphthalate, potassium hydrogensulfate, monopotassium acetylenedicarboxylic acid, potassium pyrophosphate, potassium dihydrogenphosphate, potassium benzoate, potassium chloride, potassium hexoate (potassium salt hexoic acid), potassium acetate, potassium diphenylphosphide, potassium trimethylsilonalate, potassium phthalic acid, P-aminobenzoic acid potassium salt, monopotassium L-aspartic acid, potassium napthenate, potassium hexacyanoferrate (II), potassium hexacyanoferrate (III), potassium hexacyanocobalt II- ferrate, potassium hexacyanocobalt, potassium sodium ferricyanide, or mixture.

Example 14

A luminous combustion composition comprising:'

I) a combustion improving amount of at least one ECS compound, said compound characterized as reducing combustion

temperature and/or increasing burning velocity, having a minimum latent heat of evaporation of 21 kJ mol^{-1} at its boiling temperature, and a minimum burning rate (as measured by laminar Bunsen flame) of 40 cm/sec, said compound optionally selected from the group consisting of alcohols, aldehydes, amines, carbonic esters, .carboxylic acids, carbonates, di-carbonates, esters, di-esters, ethers, di-ethers, glycols, glycol ethers, ketones, nitrates, di-nitrates, peroxides, hydroperoxides, phenols, said compound optionally containing at least one alkyl, alkyloxy, dialkyl, dialkyloxy, polyalkyl, polyalkyloxy, aryl, amide, acetate, aldehyde, carbethoxy, carbomethoxy, carbonyl, carbonyldioxy, carboxyl, ethoxalyl, ethoxy, formyl, glycolyl, glyoxylyl, hydroxyl, imide, methoxy, methylenedioxy or nitrosyl radical, including derivatives, analogues, and homologues, and mixture;

II) a combustion improving amount of at least one non-leaded element or derivative organic or inorganic compound containing said non-lead element, selected from the group consisting of 1A, 2A, 3B, 4B, 5B, 6B, 7B, 8, IB, 2B, 3A, 4A, 5A, 6A, or 7A elements of the Periodic Chart of Elements (CAS version), and mixture, wherein said element or derivative compound, is

combustible and optionally has a minimum heating value of 4,000 Kcal/kg;

III) a combustion co-catalyst; optionally a:

IV) stabilizer,

V) a co-fuel and/or oxidizer;

VI) wherein a luminous reaction zone extends from the surface of said non-lead element or derivative compound in combustion, optionally, where resultant oxides of said non-lead element are formed in the submicron range; and

VII) wherein said composition has a thermal efficiency of at least 2% greater than unadjusted co-fuel (if any) .

Example 15

A fuel composition comprising:

I) a, hydrocarbon fuel base; and

II) an ECS oxygenate selected from the group consisting of C2 - C12 aldehydes, aldehydic acids, C2 -C12 ethers, ether acids, C1 - C15 alcohols, C2 - C12 oxides, C3 - C15 ketones, ketonic acids, C3 - C15 esters, othroesters, C3 - C12 diesters, C5 -C12 phenols, C3 - C20 glycol ethers, C2 - C12 glycols, C3 - C20 alkyl carbonates, C3 - C20 dialkyl carbonates, C3 - C20 asymmetrical alkyl carbonates, C3 - C20 di-carbonates, C1 to C20 organic and inorganic peroxides,

hydroperoxides, carboxylic acids, amines, nitrates, di-nitrates, oxalates, phenols, glacial acetic acids,•C3 to C8 hyrodoxy esters of acetic acid, methoxy methyl ester of acetic acid,acetic acid anhydrides, methoxy methyl ester of acetic acid, boric acids, orthoborates, hydroxyacids, orthoacids, anhydrides, acetates, acetyls, formic acids, nitrates, di-nitrates, nitro-ethers; and

III) an ECS metallic selected from the group consisting of [2-(cyclohexenyl)ethyl]triethoxysilane, cyclohexenyl. dimethoxymethylsilane, benzyltrimethylsilane, N-(3-(trimethoxysilyl)propyl)ethylenediamine, N-1-(3-(trimethoxysilyl)propyl)diethylenetriamine, N-(3-(trimethoxysilyl)propyl)ethylenediamine, 1-(trimethyl(silyl)pyrrolidine, triphenylsilanol, octamethyltrisiloxane, 2,2,4,4,6,6-hexamethylcyclotrisilazane, hexamethylcyctrisiloxane, hexamethyldisilane, 1,1,1,3,3,3-hexamethyl disilazane, hexamethyldisiloxane, hexamethyldisilthiane, allyltributylsilane, tetraalkylsilanes (e.g. tetraethylsilane, tetrabutylsilane, 'etc.), 3-aminopropyltriethoxysilane, benzytrimethylsilane, benzytriethylsilane, N-benzyltrimethylsilylamine,

diphenylsilanediol, dihexylsilanediol, (trimethylsilyl)cyclopentadiene, potassium methoxide, potassium ethoxide, potassium propoxide, potassium isopropoxide, potassium butoxide, potassium sec-butoxide, potassium tert-butoxide, potassium pentoxide, potassium tert-pentoxide, potassium phenoxide, potassium salt of acetic acid, potassium hydrogenphthalate, potassium hydrogensulfate, monopotassium acetylenedicarboxylic acid, potassium pyrophosphate, potassium dihydrogenphosphate, potassium benzoate, potassium chloride, potassium hexoate (potassium salt hexoic acid), potassium acetate, potassium diphenylphosphide, potassium trimethylsilonalate, potassium phthalic acid, P-aminobenzoic acid potassium salt, monopotassium L-aspartic acid, potassium napthenate, potassium hexacyanoferrate (II), potassium hexacyanoferrate (III), potassium hexacyanocobalt II- ferrate, potassium hexacyanocobalt, potassium sodium ferricyanide, or mixture; and,

IV) optionally aco-combustion catalyst; and

V) optionally a hydrocarbon base; and

VI) optionally an oxider, and

VII) wherein said fuel is a vapor phase composition characterized upon combustion as having a luminous reaction

zone extending from surface of said element.

Example 15A

The above examples, wherein said fuel optionally contains a viscous hydrocarbon base and/or an oxidizer. Said fuel further characterized as having a pH of 10.5 or less. When this fuel composition contains a hydrocarbon base, said base may have a viscosity outside normal industry standards (as set forth above). However, resultant fuel's viscosity is within industry standards.

Example 16

The example compositions above, wherein the oxygenate is selected from MTBE, ETBE, TAME, methanol, ethanol, DMC, DEC, or mixture, and said ESC metal is optionally hexamethyldisilane.

Example 17

The example compositions above, wherein the oxygenate is selected from MTBE, ETBE, TAME, methanol, ethanol, DMC, DEC, or mixture, and said ECS metallic is optionally potassium ethoxide.

Example 18

The fuel compositions above, wherein the oxygenate is

selected from MTBE, ETBE, TAME, methanol, ethanol, DMC, DEC, or mixture, and said ECS metallic! is optionally [2-(cyclohexenyl)ethyl]triethoxysilane.

Example 19

The fuel compositions above, wherein the oxygenate is selected from MTBE, ETBE, TAME, methanol, ethanol, DMC, DEC, or mixture, and said ECS metallic i.s optionally potassium hexacyanoferrate (II), potassium hexacyanoferrate (III), potassium hexacyanocobalt II- ferrate, potassium hexacyanocobalt, potassium sodium ferricyanide, or mixture.

Example 20

The above compositions, wherein the oxygenate is a dialkyl carbonate and the pH is substantially neutral.

Example 21

A fuel composition comprising:

I) a hydrocarbon fuel base, and

II) a co-combustion agent selected from the group consisting of trimethoxymethylsilane, ethoxytrimethylsilane, isobutyltriethoxysilane, tetramethylsilane, dimethoxy-methyl-vinyl-silane, methyltriethoxysilane, 3-aminopropyl-triethoxysilane,

3-aminopropyl-trimethoxysilane, vinyltrimethoxysilane, diethoxydimethylsilane, dimethoxydimethylsilane, vinyltris(2-butyldenaminooxy)silane, tetramethoxysilane, tetraethoxysilane, tetrapropyloxysilane, tetraisopropylsilane, tetraisobutylsilane, dimethylphosphite, dipropylphosphite, diethylphosphite, dibutylphosphite, di-tert-butylphosphite, trialkylphosphites trimethylphosphite, triethylphosphite, triisopropylphosphite, tributylphosphite), dimethylmethylphosphonate, diethylmethylphosphonate, potassium pryophosphite, trimethylorthoacetate, triethylorthoacetate, trimethylorthdbutyrate, triethylorthobutyrate, trimethylorthovalerate, trimethylorthoformate, including homolgues, analogues, isomers, derivatives, and mixture thereof.

Example 22

A fuel composition comprising: a hydrocarbon base; a combustion improving amount of an ECS metal is a combustible compound is selected from methylcyclopentadienylmanganese tricarbonyl, [2-(cyclohexenyl)ethyl]triethoxysilane, cyclohexenyl dimethoxymethylsilane, benzyltrimethylsilane, N-(3-(trimethoxysilyl)propyl)ethylenediamine, N-1-(3-(trimethoxysilyl)propyl)diethylenetriamine,

N-(3-(trimethoxysilyl)propyl)ethylenediamine, 1-(trimethyl(silyl)pyrrolidine, triphenylsilanol, octamethyltrisiloxane, 2,2,4,4,6,6-hexamethylcyclotrisilazane, hexamethylcyctrisiloxane, hexamethyldisilane, 1,1,1,3,3,3-hexamethyl disilazane, hexamethyldisiloxane, hexamethyldisilthiane, allyltributylsilane, tetraalkylsilanes (e.g. tetraethylsilane, tetrabutylsilane, etc.), 3-aminopropyltriethoxysilane, benzytrimethylsilane, benzytriethylsilane, N-benzyltrimethylsilylamine, diphenylsilanediol, dihexylsilanediol, (trimethylsilyl)cyclopentadiene, potassium methoxide, potassium ethoxide, potassium propoxide, potassium isopropoxide, potassium butoxide, potassium sec-butoxide, potassium tert-butoxide, potassium pentoxide, potassium tert-pentoxide, potassium phenoxide, potassium salt of acetic acid, potassium hydrogenphthalate, potassium hydrogensulfate, monopotassium acetylenedicarboxylic acid, potassium pyrophosphate, potassium dihydrogenphosphate, potassium benzoate, potassium chloride, potassium hexoate (potassium salt hexoic acid), potassium acetate, potassium diphenylphosphide, potassium trimethylsilonalate, potassium

phthalic acid, P-aminobenzoic acid potassium salt, monopotassium L-aspartic acid, potassium napthenate, potassium hexacyanoferrate (II), potassium hexacyanoferrate (III), potassium hexacyanocobalt II- ferrate, potassium hexacyanocobalt, potassium sodium ferricyanide, or mixture,optionally,a combustion improving amount of an ECS oxygenate selected from/MTBE, ETBE, DMC, methanol, ethanol, or mixture; optionally a co-combustion catalyst.

Example 23

The composition of 21, wherein the ECS metallic is selected from potassium ethoxide, [2-(cyclohexenyl)ethyl]triethoxysilane, potassium hexacyanoferrate (II), potassium hexacyanoferrate (III), potassium hexacyanocobalt II- ferrate, potassium hexacyanocobalt, potassium sodium ferricyanide, or mixture.

Example 24

The composition of 21, wherein an. ESC oxygenate is employed.

Example 25

The composition of 21, containing a co-combustion agent iselected from the group consisting of trimethoxymethylsilane, ethoxytrimethylsilane, isobutyltriethoxysilane,

tetramethylsilane, dimethoxy-methyl-vinyl-silane, methyltriethoxysilane, 3-aminopropyl-triethoxysilane, 3-aminopropyl-trimethoxysilane, vinyltrimethoxysilane, diethoxydimethylsilane, dimethoxydimethylsilane, vinyltris(2-butyldenaminooxy)silane, tetramethoxysilane, tetraethoxysilane, tetrapropyloxysilane, tetraisopropylsilane, tetraisobutylsilane, dimethylphosphite, dipropylphosphite, diethylphosphite, dibutylphosphite, di-tert-butylphosphite, trialkylphosphites trimethylphosphite, triethylphosphite, triisopropylphosphite, tributylphosphite), dimethylmethylphosphonate, diethylmethylphosphonate, potassium pryophosphite, trimethylorthoacetate, triethylorthoacetate, trimethylorthobutyrate, triethylorthobutyrate, trimethylorthovalerate, trimethylorthoformate, including homolgues, analogues, isomersj derivatives, and mixture thereof.

Example 26

The example of various fuel compositions contained herein, containing a hydrocarbon base, whose viscosity is greater than acceptable' industry standards (as set forth above); wherein the resultant fuel composition has a pH of less than 11 (more

preferrable less than 10.5, 10.0, 9.5, 9.0, 8.5, 8.0, 7.5, 7.0, 6.9, 6.8, but a above 4.5, 5.5, 6.0, 6.3, 6.5 or the other ranges set forth herein, and wherein the resultant fuel meets acceptable industry standards for viscosity.

Example 27

An improved fuel composition containing an alkyl carbonate (dimethyl and/or diethyl carbonate) an ECS metal selected from an alkali/alkali earth metal derivative, and optionally a co-combustion catalyst, a hydrocarbon base or co-fuel(propellant), and/or oxidizer, wherein the pH as less than about 10.5, 9.0, 8.0, 7.5, 7.0, 6.9, or less, but greater than 4.5, 5.5, or 6.3.

STABILIZERS

In the practice of this invention, certain metallic (non-metallic) formulations are hydroscopic or tend to destabilize particularly when in combination with hydrocarbon co-fuels. For example, Applicant has found alkali/alkali earth metals to be particularly susceptible to destabilization, especially where there is a presence of water. Other formulations need to be stabilized due to the presence of Applicant's ingredients. Fuel destabilization can be undetectable, to mild, to severe, and ultimately result in the

complete fuel oxidation.

Thus, it is an embodiment to employ certain classes of stabilizers. Several are also act as co-combustion agents and/or ECS compounds.

Principal stabilizers include ployalkyloxysilanes, glycols, glycol ethers, including alkylene glycols, glycol esters, glycol acetates, and aromatic hydrocarbons, aromatic solvents, including toluenes, naphthalenes, napthas and the like.

Non-limiting examples of contemplated polyalkyloxysilanes include trimethoxymethylsilane, and those compounds, including homologue, analogue, isomers, and derivative, which are set forth above in co-combustion catalyst. Applicant has found TMMS is be particularly useful.

Non-limiting examples of glycols and glycol ethers contemplated herein include Polyhydric Alcohols (including derivative, homologue and analogues thereof)

i. Dihydric Alcohols, Glycols, 1,2,-Diols

1. polyethylene mono/polyalkyl/aryl ethers

2. polyethylene mono/polyalkyl

ethers/esters/acetates/carbonates

a.

ethylene/diethylen

e

alkyl/diakyl/aryl/alkylaryl glycol

ethers/acetates/carbonates

3. Carbitols™ ethers/acetates

ii. Trihdyric Alcohols, Glycerol, propane-1,2,3,triol

iii. Tetrahydric Alcohols

iv. Pentahydric Alcohols

v. Hexhydric Alcohols

vi. And derivative

B. Polyhydric Alcohol derivative, homologue and analogues

i. Aliphatic Hydroxy-Aldehydes

ii. Hydroxyketones

iii. Aliphatic Dialdehydes

iv. Ketonealdehydes/Diketones

v. Saturated Aliphatic Dicarboxylic Acids

vi. And derivative

Non-limiting examples contemplated herein include

glycol esters, diesters, ethers, diethers, monesters, monethers, aldehydes, nitrates, nitrites, amines, acetates/carbonates. Suitable glycol ethers include C3 to C25 combustible glycol/diglycol derivative, analogue, homologue compounds, including glycol or polyglycol ethers/acetates/esters/carbonate/carbamate/esters (hereinafter "GLYCOLS'), including but not limited to: diethylene glycol alkyl ethers, diethylene glycol dialkyl ethers, diethylene glycol aryl ethers, diethylene glycol alkyl ether acetates, diethylene glycol dialkyl ether acetates, diethylene glycol monoalkyl ether acetates, diethylene glycol aryl ether acetates, diethylene glycol alkyl acetates, diethylene glycol,acetate, diethylene glycol diacetate, diethylene glycol formate, diethylene glycol diformate, diethylene glycol butyrate, diethylene glycol dibutyrate, diethylene glycol dibenzoate', alkyl•diglycol carbonate, aryl diglycol carbonate, ethylene glycol alkyl ethers," ethylene glycol dialkyl ethers, ethylene glycol aryl ethers, ethylene glycol monoalkyl ether acetates, ethylene glycol dialkyl ether acetates, ethylene glycol aryl ether acetates, ethylene glycol alkyl acetates, ethylene glycol acetate, ethylene glycol diacetate, ethylene glycol formate,

ethylene glycol diformate, ethylene glycol butyrate, ethylene glycol dibutyrate, ethylene glycol dibenzoate, ethylene glycol monoethyl ether acetate, ethylene glycol monoethyl ether laurate, alkyl diglycol 'carbonate, aryl diglycol carbonate, ethylene glycol alkyl ether acetyl ricinoleate, ethylene glycol alkyl ether ricinoleate, ethylene glycol alkyl ether stearate, ethylene glycol monoricinoleate, ethylene glycol monostearate, glycol carbonate, glycol'carbamate, glycol diacetate, glycol dibutyrate, glycol diformate, glycol dimercaptoacetate, glycol dimercaptopropioate, glycol dipropionate, glycol stearate, glycol laurate, glycolic acid, glycol nitrate, glycol oleate, glycol pht.halte, glycol ricinoleate, diglycol carbonate, diglycol carbamate, diglycol diacetate, diglycol dibutyrate, diglycol diformate, diglycol dimercaptoacetate, diglycol dimercaptopropioate, diglycol dipropionate, diglycol stearate, diglycol laurate, diglycolic acid, diglycol nitrate, diglycol oleate,di glycol phthalte, diglycol ricinoleate, Union Carbide's CARBITOL's™ (Examples include butyl CARBITOL, butyl CARBITOL acetate, CARBITOL acetate, CARBITOL solvent, dibutyl CARBITOL, diethyl CARBITOL, N-hexyl CARBITOL, methyl CARBITOL, methyl

CARBITOL acetate (see diethylene glycol monobutyl ether, diethylene glycol monobutyl ether acetate, diethylene glycol monoethyl ether acetate, diethylene glycol monoethyl ether, diethylene glycol dibutyl ether, diethylene glycol diethyl ether, diethylene glycol monohexyl ether, diethylene glycol monomethyl ether, diethylene glycol monomethyl ether acetate, 1 2-(2-Ethyloxyethoxy)ethanol, diethylene glycol monethyl $C_6H_{14}4O_3$; Acetate $C_8Hi_{16}O_4$) .

Other non-limiting examples of glycol ethers/acetates include Carbitols™ ethers and acetates, ethylene/diethylene alkyl/diakyl/aryl/alkylaryl glycol ethers/acetates/carbonates (and substitutes), C3 to C15 alkylene glycol mono/poly alkylethers, including ethylene glycol monoalkyl ethers, diethylene glycol monoalkyl ethers, ethylene glycol

polyalkyl ethers, diethylene glycol polyalkyl ethers. Other non-limiting examples of glycols and related compounds include alkyloxy polyethylene glycols, alkyloxypolyglycols, alkylbxypolyglycol ethers, alkylene glycol acetates, alkylene glycols/esters/ethers/acetates/diacetates/ amines /glycerols/formates/ carbinols/ carbitols/nitriles, and the like, and polyalkylene glycols/esters/ ethers/

acetates/diacetates/amines/glycerols/formates/carbinols/car b itols/,nitriles, and the like.

Other non-limiting examples include: diethylene glycol dimethyl ether, diethylene glycol diethyl ether, diethylene glycol dipropyl ether, diethylene glycol diisopropyl ether, diethylene glycol dibutyl ether, diethylene glycol dipentyl ether, diethylene glycol dihexyl ether, diethylene glycol monomethyl ether, diethylene glycol monoethyl ether, diethylene glycol monopropyl ether, diethylene glycol monoisopropyl ether, diethylene glycol monobutyl ether, diethylene glycol monopentyl ether, diethylene glycol monohexyl ether, ethylene glycol dimethyl ether, ethylene glycol diethyl ether, ethylene glycol dipropyl ether, ethylene glycol diisopropyl ether, ethylene glycol dibutyl ether, ethylene glycol dipentyl ether, ethylene glycol dihexyl ether, ethylene glycol monomethyl ether, ethylene glycol monoethyl ether, ethylene glycol monopropyl ether, ethylene glycol monoisopropyl ether, ethylene glycol monobutyl ether, ethylene glycol monopentyl ether, ethylene glycol monohexyl ether, methoxy diethylene glycol, ethoxy diethylene glycol, propoxy diethylene glycol, butoxy diethylene glycol, methoxy ethylene glycol, ethoxy ethylene glycol, propoxy ethylene glycol, butoxy

ethylene glycol, methoxyglycol, ethoxyglycol, propoxyglycol, butoxyglycol, pentoxyglycol, methoxydiglycol, ethoxydiglycol, propoxydiglycol, butoxydiglycol, pentoxydiglycol, methoxytriglycol, ethoxytriglycol, propoxytriglycol, butoxytriglycol, pentoxytriglycol, methoxytertglycol/ ethoxytertglycol, propoxytertglycol, butoxytertglycol, pentoxytertglycol. Also contemplated are Union Carbide's Cellosolve solvents, including Methyl Cellosolve, Ethyl Cellosolve, Propyl Cellosolve, Butyl Cellosolve, Pentyl Cellosolve, Hexyl Cellosolve; Union Carbine's Carbitol solvents, including Methyl Carbitol, Ethyl Carbitol, Propyl Carbitol, Butyl Carbitol, Pentyl Carbitol, diethyl carbitol and the like.

Additional non-limiting examples of other acceptable glycols include: triethylene glycol, 3-aminopropyl ether triethylene glycol, diacetate triethylene glycol, monobutyl ether triethylene glycol, monomethyl ether triethylene glycol, monopropyl ether triethylene glycol, tetraethylene glycol, dibutoxytetraethylene glycol, diacetate tetraethylene glycol, aminopropyl ether tetraethylene glycols, monobutyl ether tetraethylene glycol, monomethyl ether tetraethylene glycol, dimethyl ether tetraethylene glycol, diethyl ether

tetraethylene glycol, monoethyl ether tetraethylene glycol, monopropyl ether tetraethylene glycol, tetraethylenepentamine, tripropylene glycol, tetrapropylene glycol, dipropylene glycol, propylene glycol monomethyl ether, propylene glycol monopropyl ether, ethylene glycol monobutyl ether, propylene glycol monomethyl ether, diethylene glycol monoethyl ether, diethylene glycol monobutyl ether, dipropylene glycol monobutyl ether, tripropylene glycol monomethyl ether, propylene glycol, ethylene glycol, hexylene glycol, dipropylene glycol, diethylene glycol, triproylene glycol, tetraethylene glycol, tetramethylene glycol, tetrapropylene glycol, polyethylene glycol (200, 300, 400, 600, 1000, 1500, 1540, 4000, 6000 Ashland Chemical), polyethylene glycol 3350 (Spectrum), polypropylene glycol (P400, P1200, P2000, P4000 Ashland Chemical), diacetate diethylene glycol, diethyl ether diethylene glycol, dioleate diethylene glycol, mono (2 hydroxylpropyl) ether diethylene glycol, monomethyl ether acetate diethylene glycol. In the practice of this invention, homologues, analogues, isomers and derivative of the above are contemplated. Other polyglycols including polypropylene gropylenediolslycol are contemplated. Applicant's Blending Agents include all polyhydric alcohols (including derivative, homologue and analogues thereof,

including GLYCOLs, glycol ethers, acetates, carbonates, esters, GLYCEROLS, Ethythritol's and the like) as may be set forth in patents published by the U.S Patent, EPO Publication, or within the literature, expressly including those found in CRC Handbook of Chemistry and Physics, Lide, 74th (all earlier and subsequent editions, Ann Arbor, CRC Press), Sigma-Aldrich Chemical Directory, Aldrich Chemical Company (1994 and subsequent editions), Catalog Handbook of Fine Chemicals (Aldrich 1996-1997 and subsequent editions), The Aldrich Structure Index (Aldrich Chemical, Milwaukee,WI, 1996 and subsequent editions), Handbook of Organic Chemistry, H.Beyer, W. Walter (Prentice Hall 1996), Chemical Abstract Service (CAS), (including line Registry File [1]), American Chemical Society, Chemical Abstract Service, Ohio State University, (From 1907 to present), The Merck Index, 11th Ed., Budavari, O'Neil, Merck Research Laboratories, N.J. (1989 and subsequent editions), Hawley's "Condensed Chemical Dictionary," 12th Edition, Richard J. Lewis, Sr., 1993, Handbook of Industrial Chemical Additive: An International Guide by Product Tradename, Function and Supplier (M. Ash and I Ash, VCH Publishers, NY, NY, 1991 and subsequent editions) are contemplated and are herein incorporated by reference.

Polyhdyric alcohols (glycols) may simultaneously serve multiple roles, including as an ECS compound, a Blending Agent.

C3 to C15 alkylene glycol mono/poly alkylethers, including ethylene glycol monoalkyl ethers, diethylene glycol monoalkyl ethers, ethylene glycol polyalkyl ethers, diethylene glycol polyalkyl ethers. Other non-limiting examples of glycols and related compounds include alkyloxy polyethylene glycols, alkyloxypolyglycols, alkyloxypolyglycol ethers, alkylene glycol acetates, alkylene glycols/esters/ethers/acetates/diacetates/ amines /glycerols/formates/carbinols/carbitols/, nitriles, and the like, and polyalkylene glycols/esters/ethers/acetates/ diacetates/amines/glycerols/formates/carbinols/carbitols/ni t rilesand the like.

Other non-limiting examples include: diethylene glycol dimethyl ether, diethylene glycol diethyl ether, diethylene glycol dipropyl ether, diethylene glycol diisopropyl ether, diethylene glycol dibutyl ether, diethylene glycol dipentyl ether, diethylene glycol dihexyl ether, diethylene glycol

monomethyl ether, diethylene glycol monoethyl ether, diethylene glycol monopropyl ether, diethylene glycol monoisopropyl ether, diethylene glycol monobutyl ether, diethylene glycol monopentyl ether, diethylene glycol monohexyl ether, ethylene glycol dimethyl ether, ethylene glycol diethyl ether, ethylene glycol dipropyl ether, ethylene glycol diisopropyl ether, ethylene glycol dibutyl ether, ethylene glycol dipentyl ether, ethylene glycol dihexyl ether, ethylene glycol monomethyl ether, ethylene glycol monoethyl ether, ethylene glycol monopropyl ether, ethylene glycol monoisopropyl ether, ethylene glycol\ monobutyl ether, ethylene glycol monopentyl ether, ethylene glycol monohexyl ether, methoxy diethylene glycol, ethoxy diethylene glycol, propoxy diethylene glycol, butoxy diethylene glycol, methoxy ethylene glycol, ethoxy ethylene glycol, propoxy ethylene glycol, butoxy ethylene glycol, methoxyglycol, ethoxyglycol, propoxyglycol, butoxyglycol, pentoxyglycol, methoxydiglycol, ethoxydiglycol, propoxydiglycol, butoxydiglycol, pentoxydiglycol, methoxytriglycol, ethoxytriglycol, propoxytriglycol, butoxytriglycol, pentoxytriglycol, methoxytertglycol, ethoxytertglycol, propoxytertglycol, butoxytertglycol, pentoxytertglycol. Also contemplated are

Union Carbide's Cellosolve solvents, including Methyl Cellosolve, Ethyl Cellosolve, Propyl Cellosolve, Butyl Cellosolve, Pentyl Cellosolve, Hexyl Cellosolve; Union Carbine's Carbitol solvents, including Methyl Carbitol, Ethyl Carbitol, Propyl Carbitol, Butyl Carbitol, Pentyl Carbitol, diethyl carbitol and the like. Additional non-limiting examples of other acceptable glycols include: triethylene glycol, 3-aminopropyl ether triethylene glycol, diacetate triethylene glycol, monobutyl ether triethylene glycol, monomethyl ether triethylene glycol, monopropyl ether triethylene glycol, tetraethylene glycol, dlbutoxytetraethylene glycol, diacetate tetraethylene glycol, aminopropyl ether tetraethylene glycols, monobutyl ether tetraethylene glycol, monomethyl ether tetraethylene glycol, dimethyl ether tetraethylene glycol, diethyl ether tetraethylene glycol, monoethyl ether tetraethylene glycol, monopropyl ether tetraethylene glycol, tetraethylenepentamine, tripropylene glycol, tetrapropylene glycol, dipropylene glycol, propylene glycol monomethyl ether, propylene glycol monopropyl ether, ethylene glycol monobutyl ether, propylene glycol monomethyl ether, diethylene glycol monoethyl ether, diethylene glycol monobutyl ether, dipropylene glycol

monobutyl ether, tripropylene glycol monomethyl ether, propylene glycol, ethylene glycol, hexylene glycol, dipropylene glycol, diethylene glycol, triproylene glycol, tetraethylene glycol, tetramethylene glycol, tetrapropylene glycol, polyethylene glycol (200, 300, 400, 600, 1000, 1500, 1540, 4000, 6000 Ashland Chemical), polyethylene glycol 3350 (Spectrum), polypropylene glycol (P400, P1200, P2000, P4000 Ashland Chemical), diacetate diethylene glycol, diethyl ether diethylene glycol, dioleate diethylene glycol, mono (2 hydroxylpropyl) ether diethylene glycol, monomethyl ether acetate diethylene glycol. In the practice of this invention, homologues, analogues, isomers and derivative of the above stabilizers are contemplated.

Other non-limiting examples include nonvolatile, nonion compounds, including alkylanoic acids (ethanoic, propanoic, butanoic, pentanoic, and hexanoic acids), their acetates, esters and ethers. Related ethenes, butenes, propenes, hexenes, pentenes are acceptable.

Other stabilizers of this invention may be selected from alcohols, ketones, ethers, esters, phenols, acetals, acid azides, acid halides, acids and acid derivatives (aldehydic, aliphatic dicaroxylic, alipatic monocarboxylic, aliphatic

polycarboxylic, amino acids, hydroamic, hydroxyacids, imidic, ketonic, nitrolic, orthoacids, peracid, etc.), acetic acids, acetic anhydrides, acetic acid esters, aldehydes, aliphatic hydrocarbons (including high boiling point material), amides, amidines, amidoximes,

anhydrides, aromatic hydrocarbons, azides, azines, azelates, azo compounds, betaines, bromoactealdehydes, bromoethanes, bromoethylenes, bromoacetic acids, bromobutanes, bromobutenes, bromobutylenes, bromo ethers, di bromo compounds, butyric acids, butanoic acids, butanoic esters, esters, orthoesters, acetates, ethylene acetates, esters, hydrates, hydrides, hydroperoxides, hydroxamic acids, hydroxyacids, imides, imidic acids, imines, ketenes, lactams, lactones, glycolic acids, butyric acids, heptic acids, valeric acids, isocaproic acids, nitrolic acids, nitrosolic acids, octanoic acids, esters of octanoic acids, onium compounds, orthoacids, ortho borates, octynes, octenes, octanones, oximes, esters of oxalic acid, oxalic acids, ethanoic acids, esters of ethanoic acids, esters of nonanoic acids, propanoic acids, esters of propanoic acid, pentanoic acids, propanediones, propanones, ethenes, propenes, butenes, pentanes, petenes, hexenes, esters of pentanoic acids, butanoic acids, oxalic esters, esters of butanoic acids, pentaneoic acids,

esters of pentaneoic acids, pentanedioic acids, esters of pentanedioic acids, 2-or 3-pentanones, hexanoic acids, esters of hexnoic acids, heptanoic acids, esters of heptanoic acids, esters of formic acid, glycol esters, octenes, octanone(s), oxalic acids, esters of oxalic acids, esters of hexanoic acid, hexanones, pentanedials, peroxides, furans, esters of 2-furancarboxylic ,, acids, fuirfurals, propenes, propenoic acids, esters of propenoic acids, ethers, butenedioc acids, bromo-alcohols, ethanetriols, propanetriols, butanetriols, pentanetriols, naphthalenes, hexanetriols, septanetriols, octanetriols, nitrobenzene, iodobenzene, 2-nitrophenol, cyclohexylamine, dibutylamine, diethylamine, diethylenetriamine, diethylethanolamine, diisopropanolamine, morpholine, triethylamine, triethylenetetramine, triisopropanolamine, amino methyl propanol, propylene oxide, propylene glycol, 1,2 propanediol carbonate, salicylic acid, succinic acid, tartaric acid, tannic acid, 2 , 2 , 4-trimethylpentane, dimethylbenezenes, dimethyl formamide, n-methyl-2 pyrrolidone, amyl alcohol (primary), cyclohexanol, 2-ethylhexanol, methyl amyl alcohol, tetrahydrofurfuryl alcohol, TEXANOL ester alcohol (Eastman Chemical), UCAR Filmer IBT (Union Carbide Corp.), amyl acetate, dibase ester, ester

solvent EEP (Ashland Chemical), 2-ethylexyl acetate, glycol ether acetates (DB, DE, DPM, EB, EE, PM, Ashland Chemical), isobutyl acetate, isobutyl isobutyrate, n-pentyl propionate, cyclohexanone, 2-hexanone, 3-hexanone, 2-methyl-3-pentanone, 3-methyl-2-pentanone, 4-methyl-2-pentanone, 3,3-dimethyl-2-butanone, diactone alcohol, diisobutyl ketone, ethyl methyl ketone, pinacolone, methone, 3,3-diphenyl 2-butanone, 1-hydroxy 2-butanone, 3-hydroxy-(dl) 2-butanone, 3-methyl 2-butanone, oxime 2-butanone, 2-butanone, 2-methyl proponoic acid, cyclopentanone, cyclopropyl methyl ketone, 2-tetrahdrofurylmethanol, cyclohexanone, isophorone, methyl amyl ketone, methyl isoamyl ketone, acetonylacetone, acetic anhydride, benzyl alcohol (a-hydroxytoluene) and variations, triisobutylene, tetraisobutylene, allylidene diacetate, acetol, 1 (4-methyoxyphenyl)-2- propanone, isobutyrophenone, acetonylbenzene, butyl acetate, aliphatic alcohols, n-butylbutyrate, cetyl alcohol, cyclohexane, cyclohexanol, cyclohexanone, diethylphthalate, 2,5 dimethoxytetrahydofuran, p-dioxane, 1,3-dioxane, 1,4-dioxane, 5-hydroxy-2-methyl-1,3-dioxane, glycol methylene ether, propylene carbonate, isopropylene carbonate, glycerin, 1,2,3-propanetriol, heptane, n-hexane, 2-methylpentane,

3-methylpentane, methycyclopentane, 1,4-benzenediol, isopentyl alcohol, methyl ethyl ketone, 4-methyl-2-pentanone, methyl propyl ketone, diisopropyl ketone, 1- or 3- or 4- or 5 hydroxy 2- pentanone, diisopropyl ketone, methyl propyl ketone, diacetone alcohol, isopentyl phenyl ketone, 2-pentanone, diacetone alcohol, isopentyl phenol ketone, n-butyl phenol ketone, i-butyl phenol ketone, 2-butyl phenol ketone, isopropyl acetone, 2-or 3- or 4-methoxy phenol, dihydrate oxalic acid, pentane, phenol, 3-methoxy phenol, 1,2 or 1,3 or 1,4 or 2,4 or 2,5 or 2,6 or 3,4 or 3,5 dimethyphenol, 1-octene, isobutyl 2-methylpropanate, 2-phenoxyethanol, ethylene acetate, ethyl acetate, acetonphenone, benzyl acetate, 1,3 or 1,4 or 2,3 butanediol, formaldehyde, formamide, triethyl ester orthoacetic acid, trimethyl ester orthoacetic acid, oxalic ester (diethyl ester oxalic acid), methyl hydroperoxide, ethyl hydroperoxide, acetyl peroxide, ethyl peroxide, di(tert-butyl) peroxide, acetic anhydride, 2-ethyl butyl ester acetic acid, cresyl acetates, methylglycolate, methylester phenoxy acetic acid, nitrile acid, butyric acid, butanoic acid, 2-butyl butanoic acid, 2-ethyl butanoic acid, tert-butyl butanoic acid, butyl nitril, propyl ester butanic acid, diethyl acetic acid, acetonacetic acid, allyl acetoneacetate, diacetylacetone,

acetylacetone, ethyl ester benzoic acid, butanic methyl ester, butanic ethyl ester, butanic propyl ester, isoamyl butyrate, propyl ester butanoic acid, hexyl ester butanoic acid, 2-methyl-(d) butanoic acid, 2-methyl-(dl) butanoic acid, ethyl ester 3-methyl butanoic acid, methyl ester 3-methyl butanoic acid, isopropyl ester 3-methyl butanoic acid, 2, 2-dimethyl butanoic acid, allyl ester butanoic acid, amide butanoic acid, N,N-dimethyl butanoic acid, anhydride butanoic acid, butyl ester butanoic acid, pentyl ester butanoic ester, propyl ester butanoic acid, diethylacetic acid, 2-methyl-(d)butanic acid, methyl acetoacetate, ethyl acetoacetate, diethyl acetal, acetate, acetyl acetone, 2,2-dimethyl ether ester propanoic acid, 2-oxo ethyl ester propanoic acid, 2-oxo methyl ester propanoic acid, 2-oxo isobutyl propanoic acid, 2-oxo-isopropyl propanoic acid, methyl ester propanoic acid, ethyl ester propanoic acid, propyl ester propanoic acid, propanoic acid, glyceric acid,.1, 2 dimethoxethane, 1,2 ethanediol, 1,3 butanediol, 2,3 butanedione, 1,2,3 butanetriol, 1,2,4 butanetriol, glutaric acid, glutaric anhydride, glutaronitrile, 1,5 pentanedial, glutaraldehyde, 2,4 pentadione (CH3COCH2COCH3), pentanic acid, levulinic acid, (CH3COCH3COC02H), dimethyl suberate, octanedioc acid, 1,2,3

pentanetriol, 2,3,4 pentanetriol, formamide, bromoacetic acid, acetamide, pyruvic acid, methyloxyacetic acid, propionamide, allyl bromide, diethyl acetal propenal, diacetate propenal, propenal, 1,2 propanediol, 1,3 propanediol, glycerol, trimethyl ether glycerol, acetylpropionyl, acetylacetone, propionic acid, methyloxyacetic acid, propionamide, maleic anhydride, eis-crotonic acid, dimethyl oxalate, isobutyric acid, hydroxyisobutyric acid, ethanetriols, propanetriols, butanetriols, pentanetriols, hexanetriols, septanetriols, 1,2,3 butanetriol, 2,3,4 pentanetriol, 1,2,3 pentanetriol, 1,2,3 propanetriol, dioxypentane, 2,4-dioxypentane, hexantriols, monobutyl ether triethylene glycol, propanoic acid, anhydride propanoic acid, butyl ester propanoic acid, ethyl ester propanoic acid, pentyl ester propanoic acid, octyl ester propanoic ester, pimelic acid, suberic acid, azelaic acid, methacrylic acid, dibromobutanes (e.g. 1,2; dl-2,3; 1,4; meso-2,3; etc), tribromobutanes (e.g. 1,1,2; 1,2,2; 2,2,3; etc.), diacetamide, di(2-bromoethyl) ether, 2-ethylhexanol, furfuryl alcohol,. 2-propanone, 2-propen-1-ol, ethyl methanate, methyl ethanate, pentadioic acid, pentadioic acid diethyl ester, pentadioic acid dimethyl ester, pentadioic acid dinitril, 2,3-pentaedione, 2,4-pentadione, 1,2,3-pentanetriol,

pentanoic acid, pentanoic acid methyl ester, pentanoic acid butyl ester, pentanoic acid ethyl ester, pentanoic acid furfuryl ester, pentanoic acid hexyl ester, pentanoic acid nitrile, pentanoic acid octyl ester, pentanoic acid pentyl ester. Also included are alkyl/polyalkyl/alkylene/ polyalkylene carbinols (non-limiting examples include, carbinol, methyl carbinol, ethyl carbinol, propyl carbinol, methyl ethyl carbinol, butyl carbinol, diethyl carbinol, methyl n-propyl carbinol, dimethyl isobutyl carbinol, ethyl isopropyl carbinol, ethyl isopropyl methyl carbinol, diisopropyl carbinol, triethyl carbinol, isoamyl carbinol, dimethyl n-propyl carbinol, 2-butyl methyl carbinol, methyl isobutyl carbinol, diethyl methyl carbinol), methyl propyl ketone, methyoxacetic acid, acetoacetic acid, methyl acetate, tert-amyl acetate, ethyl acetate, glycol diacetate, 1,2-propendiol carbonate, 1,2-propanediol, 1,3-propanediol, adiponitrile, 2-amino-2-methyl-1-propanol, triethylenetetramine, butyl acetate, dimethylaniline, di-n-propylaniline, methyl isobutyl ketone, n-amyl cyanide, di-n-butyl carbonate, diethylacetic acid, diethyl formamide, diisobutyl ketone, ethyl benzoate, ethyl phenylacetate, heptadecanol, 3-heptanol, n-heptyl acetate, n-hexy ether/

methyl isopropyl ketone, 4-methyl-n-yaleric acid, o-phenetidine, tetradecanol, triethylenetetramine, 2 , 6 , 8-trimethyl 4-nonanone, ethanedial, carbonate 1,2-ethanediol, diacetate 1,2-ethanediol, dimethyl ether 1,2-ethanediol, dinitrate 1,2-ethanediol, n,n-di-methyl formic acid, n,n-di-ethyl formic acid, butyl ester formic acid, isoamyl formate, octyl pester formic acid, pentyl ester formic acid, propyl ester formic acid, isobutyl ester formic acid, propargl acetate, 2-methoxyethanol, cyclopentanone, cyclopropyl methyl ketone, ethyl propenoate, 3-methyl-2-butanone, phenol, 2-or 3-or 4- methoxyphenol, propanoic anhydride, cyclohexanone, 4-methyl-3-penen-2-one, 2- or3-Hexanone, [2, 3 or 4]-methyl-[2 or3]-pentanone, 2-heptanone, methyl phenyl ketone, diethyl benzene, and azulene.

Fuel soluble aromatic hydrocarbons are acceptable stabilizers. Benzene ring compounds and derivative are contemplated (including toluene, phenyl and derivative). Toluene is a preferred,. Non-limit ing examples of aromatic hydrocarbon stabilizers include benzene, toluene, benzaldehyde, benzin, benzl alcohol, toluene bromides, toluene cresols, toluene dimethyl amino compounds, toluene ethers, toluene oxyls, toluene alcohols. For other example, see the benzene ring

compounds and 'derivative in CRC Handbook in Chemistry and Physics, 75th Ed, Lide, CRC Press (1994-1995), "Phyical Constants of Organic Compounds," Organic Chemistry 6th Ed, T.W.G. Solomons, John Wiley & Sons, N.Y., (1995), Physical Chemistry, 5th Ed, P.W.'Atkins, Oxford University Press, U.K. (1994), Physical Organic . Chemistry, 2 Ed, N.S. Issacs, John Wiley & Sons, N.Y. (1995) and Lange's Handbook of Chemistry, 14th Ed, J.A. Dean, McGraw-Hill, N.Y. (1992), are hereby incorporated herein by reference.

Acceptable concentrations of polyhdyric alcohols, glycols, stabilizers and the like include 0.001 to 40.0% volume, 0.001 to 30.0% volume, 0.001 to 25.0% volume, 0.001 to 20.0% volume, 0.001 to 10.0% volume, 0.001 to 5.0% volume, 0.001 to 4.0% volume, 0.001 to 3.0% volume, 0.001 to 2.0% volume, 0.001 to 1.0% volume, 0.05 to 2.0% volume, 0.05 to 5.0% volume, 0.05 to 8.0% volume, 0.05 to 10.0% volume, 0.05 to 15.0% volume, 0.05 to 20.0% volume, 0.1 to 10.0% volume, 1.0 to 40.0% volume, 1.0 to 30.0% volume, 1.00 to 20.0% volume, 1.00 to 10.0% volume, 1.00 to 8.0% volume, 1.0 to 5.0% volume, 1.0 to 4.0% volume, 1.0 to 3.0% volume,2.0 to 40.0,% volume, 2.0 to 30.0% volume, 2.00 to 20.0% volume, 2.00 to 10.0% volume, 2.0 to 5.0% volume, 2.0 to 4.0% volume, 2.0 to 3.0% volume. Other concentrations include volume % equal

to, greater than,or less than 0.05%, 0.1%, 0.5%, 0.8%, 1.0%, 1.5%, 2.0%, 2.5%, 3.0%, 3.5%, 4.0%, 4.5%, 5.0%, 5.5%, 6.0%, 6.5%, 7.0%, 8.0%, 9.0%, 10%.

Any concentration level that improves fuel soluability, stability or that achieves a measurable or observable flame front combustion improvement is contemplated herein.

Examples 27A

The above compositions containing an ECS metallic selected from group,of.alkali or alkali earth metals, including derivative compounds, said composition additionally containing a stabilizer selected from the group of trimethoxysilane, toluene, a glycol, a glycol ether (including mono/polyalkylene glycol mono/polyalkylethers), including homologue, analogue and derivative compounds and mixture.

pH MODIFICATION

A desirable pH range of the fuel composition of the present invention, particularly when DMC is employed, is from approximately 4.5 to approximately 10.5, with a more desirable pH range of from approximately 4.5 to approximately 9.5. An even more desireable pH range is from approximately 4.5 to 9.0. Another highly preferred pH range is from approximately 5.5. to 8.0. A preferred pH range is from approximately 4.5 to

approximately 6.5. The most preferred pH range for the fuel composition of the present invention is from approximately 6.3 to approximately 6.8. It is an object of this invention to keep pH as close to neutral as possible, such that if alkaline, it is only weakly alkaline (i.e., preferably equal or less than 11.0, 10.5, 10.0, 9.5, 9.0, 8.5, 8.0 pH), but that it preferably be either substantially neutral (i.e., 6.5 to 7.5) or slightly acidic (6.3 to 6.9 pH).

When the pH of the fuel composition of the present invention is less than 11.0, preferably 10.5 or below, 9.5 or below, and more preferably 8.5 or below, the fuel, whether anhydrous or hydrous, may be stored at ambient temperature (65°F) and as high as 95 F for up to 6 months, or more, absent hydrolysis.

For example, Applicant tested a fuel containing 5% by volume dimethyl carbonate, 95% by volume unleaded regular grade commercially available 87 octane (R+M)/2, 1/8 gram Mn/gal of methylcyclopentadienyl manganese tricarbonyl, a pH of 7.0, and 5% by volume of water, which was stored for six months at temperature ranging from 65°F to 90°F. Afterwards, the fuel exhibited no hydrolysis.

The same fuel composition was subsequently titrated with

glacial acetic acid to a pH of 6.4, still containing 5% by volume of water and was then stored for six months under the same conditions. After which period the fuel exhibited no signs of hydrolysis.

However, the same fuel composition was prepared with a pH of approximately 11.0, and contained 5% by volume of water and was stored for six months under the same conditions. The fuel showed slight evidence of hydrolysis. The same fuel with an adjusted a pH of 12.5, however, showed even stronger evidence of hydrolysis.

It should be appreciated that although acetic acid was used to acidify the pH of the fuel in the present test case, other fuel soluble acids, including but not limited to benzoic acid derivatives e.g. 2,4-dimethyl benzoic acid, methyl red, p-tert-butylbenzoic acid, 2-(1-methylethyl) benzoic acid, benzoic acid anhydride, 4-benzoyl benzoic acid, 2,4-dihdroxy benzoic acid, 2,4-dimethyl-benzoic acid, 3-ethoxy benzoic acid, 2-hydroxy-4-methyl benzoic acid, 2-hydroxy benzontrile, 4-methoxy benzotrile, acetic acid derivatives, e.g. anhydride acetic acid, chloroacetic acid, decyl ester acetic acid, dibromoacetic acid, and the like, may be employed. Fuel soluble acids are incorporated, by reference. See for example <u>CRC</u>

Handbook of Chemistry and Physics, 75th Ed, Lide, CRC Press (1994-1995) "Dissociation Constants for Inorganic Acids and Bases," and "Dissociation Constants for Organic Acids and Bases," incorporated herein by reference. If an additive acid is employed, it is preferred it be compatible with the base fuel, the metallic and have low toxicity, low corrosivity, and be as envirnomentally friendly as possible.

Naturally, acidic fuel components, which are indigenous to the fuel composition, e.g. base fuel, ECS metallic, ECS oxygenate, or an additional co-combustion catalyst, or ECS component (e.g. aldehydic acids, ketonic acids, carboxylic acids, hydroxyacids, orthoacids, formic acids, and the like) should be ultilized to achieve target pH's, prior to addition of an additive acid. Individual circumstances will dictate proper approach and additive. Acidic metals of this invention may be used individually and/or in .conjunction with' one or more other metallics to reduce pH. Non-limiting examples of such acidic metallics include binary, ternary and higher'metallic acid salts, hydroxy acids, phosphoric acids, etc., oxamic acid, lithium acetate acid, lithium salt acetic acid, propanoic acid lithium salt, cyclohexanebutyric acid lithium salt, aminobenzole acid lithium salt,/borate ester, dimethyl borate,

di-n-butyl borate, dicyclohexyl borate, didodecylborate, di-p-cresyl borates, boric acids, orthoborates, phenylboronic acid, diphenylboronic acid, o-tolylboronic acid, p-tolylboronic acid, m-tolylboronic aqid, cylohexylboronic acid, cylohexenylboronic acid, cyclopentylboronic acid, methylphenylboronic acid, methylcylohexylboronic acid, methylcyclopentylboronic acid, methylbenzylboronic acid, dimethylphenylboronic acid, dimethylcylohexylboronic acid, dimethylcyclopentylboronic acid, dimethylbenzylboronic acid, diphenylboronic acid, dibenzylboronic acid, dicylohexylboronic acid, dicylohexenylboronic acid, dicyclopentylboronic acid, methyldiphenylboronic acid, bis[(methyl)cylohexyl]boronic acid, bis[(methyl)cyclopentyl]boronic acid, bis[(methyl)benzyl]boronic acid, bis[(dimethyl)phenyl]boronic acid, bis[(dimethyl)-cylohexyl]boronic acid, bis[(dimethyl)cyclopentyl]boronic acid, or bis[(dimethyl)benzyl]boronic acid. Other acidic metallics are set forth below and contemplated.

<u>Example 28</u>

A method of minimizing hydrolysis of a vapor phase

combustion fuel composition comprising the steps of:

providing a symmetrical lower dialkyl carbonate; providing an combustion improving amount of at least one combustible compound containing at least one element selected from the group consisting of aluminum, boron, bromine, bismuth, beryllium, calcium, cesium, chromium, cobalt, copper, francium, gallium, germanium, iodine, iron, indium, lithium, magnesium, manganese, molybdenum, nickel, niobium, phosphorus, potassium, palladium, rubidium, sodium, tin, zinc, praseodymium, rhenium, silicon, vanadium, strontium, barium, radium, scandium, yttrium, lanthanum, actinium, cerium, thorium, titanium, zirconium, hafnium, praseodymium, protactinium, tantalum, neodymium, uranium, tungsten, promethium, neptunium, samarium, plutonium, ruthenium, osmium, europium, americium, rhodium, iridium, gadolinium, curium, platinum, terbium, berkelium, silver, gold, dysprosium, californium, cadmium, mercury, holmium, titanium, erbium, thulium, arsenic, antimony, ytterbium, selenium, tellurium, polonium, lutetium, astatine, mixture thereof, including their organic and inorganic derivative compounds; providing a hydrocarbon; mixing said carbonate, said combustible compound, and said Hydrocarbon so as to produce a fuel composition having a pH of from 4.5 to 9.5,

and store said composition at a temperature of no more than 90°F for up tp 6 months, or longer, and, combusting said fuel in an engine or combustor, wherein vapor phase composition occurs characterized as having a luminous reaction zone extends from surface of said element.

Example 29

The method of Example above, wherein said fuel is stored at an average temperature of 65°F for 6 months, prior to combustion.

Example 30

A method of mitigating handling hazards of an alkali/alkali earth metal based vapor phase combustion fuel , composition, comprising the steps of:

providing an combustion improving amount of a combustible compound containing at least one element selected from an alkali metal or alkali earth metal, and mixture; and a stabilizer.

Example 30A

The method of example 30, optionally providing an acidic ECS metallic; and optionally providing a hydrocarbon; and

optionally providing an ECS oxygenate; and

mixing said composition.

Example 30B

The method of examples 30, 30A, wherein the composition's target pH ranges up to 9.5.

Example 30C

A method of mitigating handling hazards of an alkali/alkali earth metal based vapor phase combustion fuel composition, comprising the steps of:

providing an combustion improving amount of at least one combustible compound containing at least one element selected from an alkali metal or alkali earth metal; and

optionally providing an acidic ECS metallic; and

optionally providing a hydrocarbon; and

optionally providing an ECS oxygenate, and

mixing said composition, said combustible compound, and said hydrocarbon so as to produce a fuel composition having a pH of from 4.5 to 9.5, and

combusting said fuel in an engine or combustor, wherein vapor phase composition occurs characterized as having a luminous reaction zone extends from surface of said element.

Example 31

The above example 30, wherein the target pH is ranges from 6.0 to 8.0.

Example 32

The above example 30, wherein the target pH is achieved by providing at least one acidic ECS metallic or acidic ECS oxygenate.

Example 33

The above example 30, wherein the acidic ECS metallic is a phosphorus derivative.

Anhydrous fuels or substantially anhydrous fuels are contemplated and particularly preferred when employing water reactive group Ia, IIa, IIb, IIIA metals and derivative compounds. Circumstances where hydrocarbon bases require anhydrous compositions are contemplated, e.g. jet aviation applications, etc.

Although anhydrous fuels are preferable, fuel compositions of the present invention may contain water.

It is noted, acidity level of Applicant's fuels may be measured in terms of equivalents, e.g., equivalents of KOH required to neutralize the fuel composition. The fuels of the present invention show improved operation at acidity levels

which are 100%, 150%, 200%, 300%, or more, above such standards. Acidity levels below such standards, including those at least 50% less, are expressly contemplated.

Also by way of example, when the fuel compositions of the present invention are used in jet turbine engines, such fuels typically must meet ASTM D 1655 specifications (incorporated herein by reference) or other international specifications, including maximum acidity levels ASTM D 3242 and IP 354 standards. However, it is believed that the increased efficiency of the fuels of the present invention are less destructive to engines during combustion, and operation with lower pH's than presently acceptable. International, industry and government fuel standards, including ASTM, IP, COST, DERD, MIL, AN, U.S. Clean Air Act, California Air Resources Board, and Swedish/European EPEFET standards, etc., governing hydrocarbon fuels containing applicant's ECS oxygenates/metallics are incorporated herein by reference.

It is an embodiment, especially when employing DMC, to maintain a pH in the desired target range and store said fuel at temperatures at or below 90° F.

Example 34

A method of maintain fuel stability, said method

comprising:

mixing a fuel composition containing an ECS metallic and a dialkyl carbonate (preferably DMC), and adjusting pH of the fuel composition to less than 10.5 pH.

In addition to the preferred pH ranges described above, it is further contemplated that Applicant's pH adjusted hydrocarbon based fuels will additionally contain known additive, including but not limited to antioxidants, co-solvents, metal deactivators, detergents, dispersants, corrosion inhibitors, mutual solvents, oxygenated anti-knock compound (e.g. hydrocarbyl ethers, alcohols, etc.), conventional combustion catalysts including ferrous picrate, Li and LH promoters, other additive, and additive set forth in incorporated PCT Applications. The metal deactivators contemplated in this invention are known in the art and incorporated herein by reference.

A preferred fuel of the present invention comprises 1) dimethyl carbonate or dimethyl carbonate, representing 0.1% to 99.5% wt of composition; 2) at least one metal as set forth below, representing 0.01% to 99.5% wt of composition; optionally a metal deactivator representing 0.00001% to 10.0% wt of composition, or an antioxidant representing 0.00001% to 10.0%

wt, or a detergent/dispersant representing 0.00001% to 10.0% wt, or an ignition promoter representing 0.000001% to 20.0% wt, or a demulsifier representing 0.00001% to 10.0% wt, or a co-solvent or salt representing 0.000001% to 40.0% wt, or a hydrocarbon representing 0.1% to 99.0% volume of the composition, or a co-combustion catalyst (described below) representing 0.000001% to 80.0% wt, or mixture. Said fuel is constructed with a pH no greater than 11.0 or 10.5, and preferably less than 9.5. More preferably, the pH is from 6.3 to 6.8. When such fuel is a jet aviation turbine hydrocarbon based-fuel, preferred acidity does not exceed equivalent of 0.1 mg KOH/g.

As described in the aforementioned PCT applications, the presence of a co-solvent is also preferred, so long as pH is maintained. Co-solvents that enhance mutual solubility of fuel components, fuel stability, water tolerance are preferred (e.g. C1 to C12 alcohols, alkanolamines, etc.). These are known in the art and incorporated herein by reference. Additionally, co-solvents that increase flash point or reduce vapor pressure are contemplated. Non-limiting examples include, ethanetriols, propanetriols, butanetriols, 1,2,3 butanetriol, pentanetriols, 1,2,3 pentanetriol, 2,3,4 pentanetriol, hexanetriols,

septanetriols, octanetriols, or tertraethylene glycol, triethylene glycol, 1-octene, high flash point ketone, naphthalenes, triethylene glycol, trimethylene glycol, isopropyl acetone, diisopropyl acetone, diisopropyl diacetone, diethylene acetate, diethylene diacetate, ethylene acetate compound, phenol, or other flash point temperature reducing co-solvent set forth in aforementioned PCT Applications. Co-solvents should not be corrosive or hazardous to fuel systems.

It is desirable the resultant fuel be constructed to have an average latent heat of vaporization (LHV) no less than typical industry standards. Preferred LHV's are generally greater. For example, the latent heat of vaporization or enthalpy of vaporization (vapH(Tb)/kJ mol^{-1}) for commercial grade diesel, gas turbine, or fuel oils range from about 90 to 105 btu/lb (at 60°F) or 18 to 21 jK/mole or (at boiling temperatures). Likewise, commercial motor gasolines have a LHV ranging from 135 to 145 btu/lb or 27 to 29 jK/mole, aviation gasolines about 130 to 150 btu/lb or 26 to 30 jk/mole, and aviation jet fuels about 105 to 115 btu/lb or 21 to 23 jK/mole.

Thus, it is preferred that the LHV for commercial grade diesel, gas turbine, or fuel oils at 60°F exceed 105 btu/lb or

21 jK/mole (at boiling temperatures), for commercial motor gasolines LHV's should exceed 145 btu/lb or 29 jK/mole, for aviation gasolines LHV's should exceed 150 btu/lb or 30 jk/mole, and for aviation jet fuels LHV's should exceed 115 btu/lb or 23 jK/mole. LHV's at least 2%, 5%, 10%, 20%, 30% or greater than these amounts are however preferred.

The burning velocities (as measured by laminar Bunsen burner flame) for commercial grade diesel, gas turbine, and fuel oils range from about 32-34 cm/sec, kerosine about 36 cm/sec, benzene about 44, automotive gasoline about 44-46 cm/sec, aviation gasoline about 44-45 cm/sec, aviation jet fuels about 32-34 cm/sec. Methanol is reported at about 57 cm/sec.

Thus, in Applicant's fuels it is desireable that burning velocities for commercial grade diesel, gas turbine, and fuel oils exceed 33, 34, 35, 36, 37, 38, 40, 41, 42, 43 cm/sec, kerosine exceed 35, 36, 37, 39, 40, 41, 42, 43, 44 cm/sec, automotive gasoline exceed 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56 cm/sec, aviation gasoline exceed 44, 45, 46, 47, 48, 49, 50, 51, 52, .53, 54, 55, 56 cm/sec, and aviation jet fuels exceed 35, 36, 37, 38, 39, 40, 41, 42, 43, 44 cm/sec. However, BV's at least 2%, 5%, 10%, 20%, 30%, or greater than the burning velocity of the unadjusted base fuel or conventional

fuel is preferred.

It is also desirable that the hydrocarbon based fuels have high possible allowable densities. High densities of base fuels permit higher concentrations of metallics and dialkyl carbonates. For example, aviation turbine densities equal or exceeding 841 kg/m^3 @ 15° C are contemplated. More generally, the fuel compositions of the present invention allow for base fuel densities of from 840 to 1200 kg/m3 @ 15° C, and even 900 to over 1200 kg/ m3 @ 15° C. Moderate, low, to very low densities are also contemplated so long as the increased burning velocity object of above PCT Applications is accomplished and a pH is not greater than 10.5, preferably below 9.0, and most preferably from 6.3 to 6.8 is maintained.

Moreover, highly viscous hydrocarbon fuel bases with viscosities above fuel specification, are unexpectedly brought to within fuel viscosity limits by the addition of dialkyl carbonates and metal. For example, is has been found that a diesel fuel oil having a viscosity of 2.6 mm^2/S at , 40° C was acceptably combined with dimethyl carbonate representing 5% volume of the composition, and 2.0 grs Mn/gal, of methylcyclopentadienyl manganese tricarbonyl (MMT) or alternative non-toxic metallic. The resultant fuel composition

had a lower viscosity of 2.4 mm2/S at 40° C.

In this way, highly viscous fuels can be adapted by the addition of applicant's ingredients, whereby non-conforming highly viscous fuels can be made less viscous and brought into compliance with ASTM International, industry and government fuel standards, including ASTM, IP, COST, DERD, MIL, AN, U.S. Clean Air Act, California Air Resources Board, and Swedish/European EPEFET standards, or other specification (herein incorporated by refererence).

Also by way of example, Jet A hydrocarbon bases having a viscosity of 8.1 to 15.0 or more, (ASTM 445) can be adapted to meet the current 8.0 mm^2/s^L at -20°C standard by addition of the components described above. Alternatively, base fuel viscosity of from 13.5 to 23.0 Cs at -30°F, or more, may be met by the addition of the components described above.

Similarly, a gas oil turbine hydrocarbon base may have maximum kinetic viscosities at 40°C equal or exceeding 2.45 to 7.0, or greater, mm2/s for ASTM D 445 No. 1-GT fuels, and be adapted to meet the 2.4 standard, by addition of the components described herein. Alternatively, base fuel kinetic viscosities of 4.15 to 6.0, or more, mm^2/s for ASTM D 445 No. 2-GT fuels, may be adapted to meet the 4.1 standard

by addition of applicant's additives, as described herein.

In an analogous manner, a diesel fuel oil base may have maximum kinetic viscosities at 40°C equal or exceeding 2.45 to 7.0, or greater, mm2/s for ASTM D 445 low sulfur or regular too. 1-D fuels, and be adapted to meet the 2.4 standard by addition of applicant's additives. Alternatively, a diesel fuel oil base having maximum kinetic viscosities of 4.15 to 9.0, or more, mm2/s for ASTM D 445 low sulfur or regular No. 2-D fuels, and be adapted to meet the 4.1 standard, by addition of applicant's additives. Similarly, fuels having- a maximum kinetic viscosity of 24.5 to 60.0, or more, mm2/s for ASTM D 445 No. 4-D fuels, and be adapted to meet 24.0 mm2/s by addition of applicant's additives. Additionally, a low emission diesel base may have viscosities exceeding 2.45 to 5.5, or more, cSt at 40°C (where 1mm2/s = 1cSt), and be adapted to meet the 2.4 standard.

Furthermore, a fuel oil base may have kinetic viscosities equal or exceeding 2.15 10.0, or more, mm^2/s at 40°C ASTM D 445 for No. 1 fuels, and can be adapted to the 2.1 standard by addition of applicant's additives. A fuel base having kinetic viscosities of from 3.45 to 10,0, or more, mm2/s at 40°C ASTM D 445 for No. 2 fuels can be similarly adapted to meet 3.4. A

fuel base having kinetic viscosities of 5.55 to 25.0 or more, mm2/s at 40°C ASTM for D 445 No. 4 fuels (Light), may be similarly adapted to meet 5.5. A fuel base having kinetic viscosities of from 24.5 to 40.0, or more, mm2/s at 40°C ASTM D445 for No. 4 fuels (regular), may be adapted to meet 24. A fuel base having kinetic viscosities of from 8.95 to 25.0, or more, mm3/s at 100°C ASTM D 445 for No. 5 fuels (Light), may be adapted to meet 8.9. A fuel base having kinetic viscosities of from 15.0 to 30.0, or more, mm3/s at 100°C ASTM D 445 for No. 5 fuels (Heavy), may be adapted to meet 14.9. A fuel base having kinetic viscosities of from 50.5 to 80.0, or more, mm3/s at 100°C STM D 445 for No. 6 fuel oils, and adapted to meet 50.0 mm3/s.

Similarly, a heavy diesel, locomotive or marine engine base fuel, exceeding ISO DIS 8217, BS MA 100, government and/or other industry viscosity specifications, but adapted to meet such standards (incorporated by reference), typically uncorrected viscosity exceeds such standards by 1.0, 2.0,10.0, 50.0, or more centistokes at 50°C. Applicant has discovered by incorporating his lower dialkyl carbonates and metals, fuels having excessive viscosities can meet government, or other viscosity standards.

By way of further example, an enhanced combustion aviation

turbine fuel composition of the present invention includes an ECS oxygenate (preferably a dialkyl carbonate and/or dialkyl dicarbonate), an ECS metal (preferably an alkali\alkali earth metal, or silicon), optionally a co-combustion catalyst, an aviation turbine hydrocarbon base having a viscosity of from 8.1 to 9.0 MM^2/S (ASTM 445); optionally one or more of the following: a salt, a co-solvent, antioxidant, freeze point additive, anti-icing additive, metal deactivator, corrosion inhibitor, hydroscopic control additive, lubricity agent, lubricant or friction modifier, anti-wear additive, combustion chamber or deposit control additive, any other recognized additive, additive disclosed in aforementioned PCT Applications, or mixture thereof. The resultant fuel is characterized as being slightly alkaline, substantially neutral or acidic, and having a maximum viscosity equal or less than 8.2 MM^2/S^1 (ASTM 445). The fuel preferably has, a density of from 840.5 to 850, or greater, kg/m^3 @ 15° C, a flash point of at least 38°C, a maximum vapor pressure of 21 kPa @ 38°C, minimum thermal stability meeting ASTM D 1655 standards, a heat of combustion or equivalent equal to or exceeding 42.8 MJ/kg (lower heats of combustion are contemplated, including those less than or equal to 42.5, 42, 41, 40, 39, 38, 37, 36 MJ/kg,

based upon additive heats of individual components) , and a maximum freezing temperature of from -40 to -50°C, optionally a LHV not less than 115 btu/lb or 23 jK/mole, optionally a burning velocity exceeding 37 cm/sec.

Example 34A

This composition may be summarized as an enhanced aviation turbine fuel composition wherein aviation turbine hydrocarbon base has a viscosity equal or exceeding 8.1 MM^2/S, a C3 to C7 symmetrical dialkyl dicarbonate, said fuel optionally characterized as being slightly acidic not exceeding equivalent of 0.1 mg KOH/g.

A diesel fuel, fuel oil, turbine gas oil composition of the present invention includes dimethyl carbonate representing 0.01% to 40.0% oxygen by weight of the fuel; a compound or element containing a combustion improving amount of transition metal, alkaline metal, alkaline earth, group IIIa, IVa, Va, VIa, VIIa element or derivative compound, or mixture, optionally a co-combustion agent, optionally in an concentration of 0.001 to about 100.0 gr element/gal, preferably 2.0 to 20.0 gr element/gal; and a No. 1 (ASTM) diesel fuel base having a viscosity of from 2.45 to 3.0, MM^2/S at 40°C, ; said fuel base optionally characterized as having one or more of the following:

a density ranging from 880 to 800 kg/m^3 , a cetane index of 40 to 70, an aromatic content by vol. ranging from approximately 0 to 35%, preferably 0% to 10%, provided that 3-ring + aromatics not to exceed 0.16 volume %; a T10 fraction temperature of about 190 to 230°C, a T 50 fraction temperature of about 220 to 280°C, a T90 fraction of about 260 to 340°C, a cloud point temperature of °C -10, -28, -32 or 6°C above tenth percentile minimum ambient temperature, a sulfur content preferably not greater than 250 ppm, more preferably not greater than 50 ppm, most preferably not exceeding 5 ppm, a bunsen laminar burning velocity of at preferably greater than 37, more preferably greater than 44, most preferably 50 ore more, cm/sec, a latent heat of vaporization of preferably at least 105, more preferably at least 120, most preferably 130 or more, BTU/lb. The resultant fuel is characterized as having a pH less than 10.5 and a viscosity equal to or less than 2.4 MM2/S at 40°C, optionally a LHV at 60°F equal or in excess of 105 btu/lb or 21, 22, 23, 25, 27 jK/mole (at boiling temperatures), optionally a minimum laminar bunsen burner flame of 37, 39, 40, 41 cm/sec.

Example 34B

A composition, wherein the fuel composition is a diesel fuel oil, the ECS oxygenate is dimethyl carbonate representing

0.01% to 40.0% oxygen by wt. of the fuel, the hydrocarbon base fuel has a viscosity equal to or greater than 2.5, MM^2/S at 40°C, and the fuel composition is characterized as having a pH less than 10.5 and a viscosity equal to or less than 2.4 MM2/S at 40°C.

An aviation gasoline fuel composition of the present invention includes an ECS oxygenate (preferably a hydrocarbyl ether, including MTBE, ETBE, etc.) and/or dialkyl carbonate, an ECS metal (preferably an alkali\alkali earth metal, or silicon), optionally a co-combustion catalyst, and an aviation gasoline base. The resultant fuel is characterized as having a pH less than 7.0 and a minimum octane or performance number of from 87 to 130 (ASTM 909). It is further characterized as having a distillation fraction wherein the sum of the T-10 plus T-50 fractions are 307° F, the T-40 temperature is 167° F and the T-90 temperature is less than 250° F, a maximum sulfur content of 0.05 wt%, or sulfur free, a latent heat of vaporization preferably exceeding 120, more preferably exceeding 150, most preferably exceeding 160 BTU/lb, a laminar bunsen burning velocity preferably equal to or in excess of 40, more preferably greater than 48, most preferably greater than 52 cm/sec, a heat of combustion (as measured by the sum of fuel

ingredients) equal or less, than 43.0 kJ/kg, or equal or less than from 18,720 to 15,000, or less, BTU/lb.

Example 34C

A gasoline composition of the present invention includes an a hydrocarbyl ether (MTBE, ETBE, etc.) and/or dialkyl carbonate, an ECS metal (preferably an alkali\alkali earth metal, or silicon), optionally a co-combustion catalyst, and an unleaded base fuel composition. The resultant composition is characterized as having a pH less than 10.5, and optionally being phosphorus free hydrocarbons, a maximum Reid Vapor Pressure of from 6.0 to 12.0 psi, 6.0 to 10 psi, 6.0 to 9.0 psi; a maximum of 12% to 5.0% by volume, or less of olefins, a maximum of 30% to 20% or less by volume of aromatics (more preferably 15% to 10%, or less), a maximum of 2.0% to 0.8% or less benzene, a maximum of 40 ppm .sulfur, most preferably sulfur free, a total O2 concentration ranging of 0.5% to 10.0% wt of dimethyl carbonate, a manganese tricarbonyl compound at 1/64 to 3/16 gr. Mn/gal (preferably 1/32 gr. Mn) or other metallic in a combustion improving amount, a maximum T-90 temperature of 330°F to 280°F, a T-50 temperature of approx. 170°F to 230°F., 175°F preferred, a minimum (R+M)/2 octane of 85, to 92, a bromine number of 20 or less, an average latent heat of vaporization

of 880 to 920, or more, BTU/gal at 60°F; a heating value greater than 106,000 btu/gal at 60°F (more preferably greater than 108,000, 114,000 btu/gal), as measured by the sum of, individual fuel substituents.

Example 34D

A fuel composition, wherein said composition is a gasoline comprising an ECS oxygenate selected from MTBE, ETBE, DMC, or ethanol, characterized as having a pH ranging form 8.5 to 5.5, optionally a maximum Reid Vapor Pressure of 12.0 psi or 8.0 psi, a maximum of 12% vol. olefins, a maximum of 30% vol. aromatics, a maximum of 1.0% vol. benzene, a maximum of 50 ppm sulfur or sulfur free, a total 02 concentration ranging from 0.5% to 4.0% wt of the composition, a maximum T-90 temperature of 330°F to 280°F, a T-50 temperature of approx. 170°F to 230°F., a minimum (R+M)/2 octane of 85, to 92, a bromine number of 20 or less, an average latent heat of vaporization of 880 to 920 BTU/gal at 60°F, a heating value greater than 106,000 btu/gal at 60°F.

Example 34E

Another gasoline composition of the present invention includes an ECS oxygenate (preferably a dialkyl carbonate and/or dialkyl dicarbonate, MTBE, ETBE, Ethanol, or methanol),

an ECS metal (preferably an alkali\alkali earth metal, or silicon), optionally a co-combustion catalyst, and an unleaded base fuel composition, characterized as having a pH less than 10.5, and optionally characterized as having one or more of the following: being phosphorus free hydrocarbons, with a maximum Reid Vapor Pressure of 12.0 psi, a maximum of 12% olefins, a maximum of 30% aromatics, a maximum of 2.0% benzene, a maximum of 50 ppm sulfur or sulfur free, a total O2 concentration ranging from 0.5% to 10.0% wt of dialkyl carbonate, a combustible metal or non-metal selected from groups set forth below including (but not limited to) those consisting of the preferred manganese, silicon, potassium, and iron compounds, or mixture, a maximum T-90 temperature of 330°F to 280°F, a T-50 temperature of approx. 170°F to 230°F., a minimum (R+M)/2 octane of 85, to 92, a bromine number of 20 or less, an average latent heat of vaporization of 880 to 920 BTU/gal at 60°F, a heating value greater than 106,000 btu/gal at 60°F (as measured by the sum of individual fuel substituents), a burning velocity exceeding 50 cm/sec, a latent heat of vaporization exceeding 29 jK/mole (or equivalent).

Example 34F

A similar gasoline composition comprises an ECS oxygenate

selected from MTBE, ETBE, DMC, or ethanol, is characterized as having a pH ranging form 8.5 to 5.5, and optionally with a maximum Reid Vapor Pressure of 12.0 psi or 8.0 psi, a maximum of 12% olefins, a maximum of 30% aromatics, a maximum of 1.0% benzene, a maximum of-50 ppm sulfur or sulfur free, a total O2 concentration ranging from 0.5% to 4.0% wt of the composition, a maximum T-90 temperature of 330°F to 280°F, a T-50 temperature of approx. 170°F to 230°F., a minimum (R+M)/2 octane of 85, to 92, a bromine number of 20 or less, an average latent heat of vaporization of 880 to 920 BTU/gal at 60°F, a heating value greater than 106,000 btu/gal at 60°F.

Example 34G

Another gasoline composition would include the aforementioned ECS oxygenates and an ECS metallic (including a combustible alkali/alkali earth metal, preferably a potassium derivative, and MTBE, ETBE, ethanol, methanol, DMC, or EMC, or substitutes as provided herein), and a gasoline base, wherein the resultant composition has one or more of the following characteristics: a RVP of 6.4 to 10.0 psi, aromatics content of 0% to 50%, more preferably no greater than 22%, 25%, 30%, or 35% vol., a benzene content of 0% to 2.0%, preferably no greater than 0.8%, 1.0%, 1.2% vol., an olefin content of 0% to

25%, preferably no greater than 15%, 12%, 10%, 8% vol., an distillation evaporation point where 30% to 70% of the fuel has distilled by 200°F, an distillation evaporation point where 70% to 100% of the fuel has distilled by 300°F, a T50 distillation temperature ranging from 200°F to 220°F, maximum T90 distillation temperature of 290°F to 310°F, oxygen by wt% ranging from 0% to 5.0%, 0.001% to 4.0%, 0.1% to 4.0% to preferably 1.8% to 2.2%., sulfur, ppm, wt. ranging from 0 to 500 ppm, more preferably 30 to 80 ppm.

Example 34H

Another gasoline composition would include the aforementioned gasoline composition, wherein the resultant composition has one or more of the following characteristics: a maximum summer RVP of 8.1, 8.0, 7.5, 7.2, 7.1, 7.0 psi, maximum aromatics of 22%, 25%, or 30% vol., [1] max. benzene of 0.8%, 1.0%, 1.2% vol., T50 distillation temperature ranging from 200°F to 220°F, a maximum T50 distillation temperature ranging from 200°F to 220°F, minimum T50 distillation temperature greater than 175°F, maximum T90 distillation temperature of 290°F to 310°F, oxygen by wt% 1.8% to 2.2%., sulfur, ppm, wt. 30 to 80.

Example 35

A gasoline composition including a combustion Improving amount of potassium ethoxide and an ECS oxygenate selected from MTBE, ETBE, ethanol, DMC, or EMC, wherein the composition has one or more of the following characteristics: a RVP no greater than 7.5, 7.1, 7.0 psi, maximum aromatics of 22%, 25%, or 30% vol., max. benzene of 1.0% vol., a minimum T50 distillation temperature ranging of 175°F, maximum T90 distillation temperature of 290°F to 310°F, oxygen by wt% 1.8% to 2.2%., and a sulfur content of 0 to 80 wt. ppm, 30 ppm or less preferred.

The invention achieves unexpected reduction of nitrous oxides in combustion after emissions pass through a catalytic exhaust converter. As noted above, reductions of nitrous oxides is important for purpose of reducing global warming gases, but catalytic converters tend to increase the amount of said oxides during their catalytic activity. Applicant has discovered that combusting his ECS oxyenate and/or metallic containing fuels, particularly those containing alkali/alkali earth metals, and emitting them through a catalytic converter, he is able to no only reduce the nitrous oxide flowing into the converter, but is able to reduce total oxides, which otherwise would be emitted from the converter.

Thus, reducing the harmful effect the exhaust, catalyst has in increasing nitrous oxides.

Example 36

A method of reducing green house nitrous oxide gases, comprising:

mixing a combustion improving amount of a combustion improving amount of an ECS metallic, optionally a combustion improving amount of an ECS oxygenate, together with a gasoline; and

combusting resultant fuel composition in an automotive engine; and

exhausting resultant emissions through an exhaust catalyst; emitting catalyst reacted emissions into the atmosphere; whereby exhaust nitrous oxide emissions are reduced.

Example 37

The Example above, wherein the ESC metal is an alkali or alkali earth metal (preferably a potassium derivative) and the oxygenate is MTBE, ETBE, ethanol, methanol, DMC, and wherein the fuel optionally contains a co-combustion catalyst.

Example 38

The Example of 36, wherein also mixed into the

composition is a co-combustion catalyst.

Example 39

The Example of 36, wherein said method incorporates mixing a metal only.

Example 40

The Example of 36 or 39, wherein said metal is absent manganese.

Example 41

The Example of 36, wherein said fuel composition is includes a combustible alkali/alkali earth metal, and an ECS oxygenate selected from MTBE, ETBE, ethanol, methanol, DMC, EMC, and mixture, having one or more of the following characteristics: a RVP of 6.4 to 10.0 psi, aromatics content of 0% to 50%,a benzene content of 0% to 2.0%, an olefin content of 0% to 25%, an distillation evaporation point where-30% to 70% of the fuel has distilled by 200°F, an distillation evaporation point where 70% to 100% of the fuel has distilled by 300°F, a minimum T50 distillation temperature of 175°F and a maximum T50 distillation temperature ranging from 200°F to 220°F, maximum T90 distillation temperature of 290°F to 310°F, a co-combustion catalyst, oxygen by wt% ranging from 0.1% to 4.0%, sulfur, ppm, wt. ranging from 6 to 500 ppm; or a fuel composition of the

character of Examples 34A through 34E and 35.

Example 42

The Example of 36 to 41, wherein the fuel composition has a pH ranging from 10.0 to 4.0., more preferably 9.0 to 5.0, 8.0 to 6.0, 7.7 to 6.3, or 6.9 to 6.3, or other range, or amount set forth herein.

Example 43

The above examples additionally containing an nitrogen based enhancer, or compound containing nitrogen, a nitrogen/oxygen combination, or a NH, NH2, NH3, NH4, NO, NN, OON, OONH, ONH, ONH2, ONH3, ONH4 , CON, CONH, CONH2, CONH3, COON, COONH, MNH, MON, MONH, MONH2, MONH3, MOON radical (where M is a metal as set forth herein). Non-limiting examples also include fuel soluble and/or combustible amines, amides/imides, such as nitro compounds, nitric compounds, tetranitromethanes, nitromethanes, nitroethanes, nitropropanes, nitrous oxides, dinitrous oxides, nitric oxides, nitrates, and di-nitrates. Other non-limiting examples include, alkylmetallicamides, polyalkylmetallicamides, alkylphosphoramides, polyalkylphosphoramides (e.g. hexamethylphosphoramide, hexamethylphosphorus diamide, hexamethylphosphorus triamide, hexamethylphospophorimidic triamide, triethylphosphoramide,

trimethylphosphoramide, tripropylphosphoramide, triisopropylphosphoramide, tributylphosphoramide, tri-isobutylphosphoramide, tri-sec-butylphosphoramide, tri-tert-butylphosphoramide, triphenylphosphoramide, dimethoxyphosphorusamide (CH30)2PNH2) , diethoxyphosphorusamide, dipropbxyphosphorusamide, diisopropoxyphosphorusamide, dibutoxyphosphorusamide, di-isobutoxyphosphorusamide, di-sec-butoxyphosphorusamide, di-tert-butoxyphosphorusamide, diphenoxyphosphorusamide, dimethylphosphoramide (CH30)2PONH2), diethylphosphoramide, dipropylphosphoramide, diisopropylphosphoramide, dibutyl-phosphoramide, diisobutylphosphoramide, di-sec-butylphosphoramide, di-tert-butylphosphoramide, diphenylphosphoramide, dimethylethylphosphoramide, diethylmethylphosphoramide, dipropylmethylphosphoramide, diisopropylmethylphosphoramide, di-butyl-methyl-phosphoramide, di-iso-butylmethylphosphoramide, di-sec-butylmethylphosphoramide, di-tert-butylmethylphosphoramide, diphenylmethyl phosphoramide).

Phosphoramides are particularly desired.

In the practice of this invention it is contemplated at least one combustible reactive non-lead transition metal, alkaline metal, alkaline earth, group IIIa, IVa (except carbon), Va, VIa (except oxygen), Vila element, or derivative thereof, as set forth herein, or mixture (herein referred to as "metal" or "metallic") be together with at least one C3 to C13 symmetrical dialkyl ester of carbonic acid, and mixture, in a fuel stable composition; said composition optionally containing a combustion catalyst as set forth below, a hydrocarbon, and/or an oxidizer; resultant composition as having a pH slightly alkaline, neutral or acidic.

Non-limiting examples of suitable dialkyl carbonates include, dimethyl carbonate, diethyl carbonate, dipropyl carbonate, diisopropyl carbonate, dibutyl carbonate, diisobutyl carbonate, ditertiary butyl carbonate, diisoamyl carbonate, methyl ethyl carbonate, diphenyl carbonate, or mixture. C3 to C8 symmetrical dialkyl carbonates are more desirable, with C3 to C5 being preferred. It is contemplated that such carbonates will be introduced into the composition in concentrations of 0.01 to 100.0 volume percent in an amount sufficient to improve combustion. The carbonates may be additionally combined with one or more oxygenated compounds,

including but not limited to alkyl butyl ethers (e.g. MTBE, ETBE, TAME, ETAME, etc.), alkyl alcohols, and/or known co-solvents. In the practice of this invention methylal, ethylal, C1 to C6 aliphatic alcohols, may be substituted for dialkyl carbonates, absent compromise of vapor phase combustion. Examples of ECS compounds are presented in the aforementioned PCT Applications.

Non-limiting examples of the optional hydrocarbon bases contemplated herein, include any hydrocarbon, including but not limited to carbonaceous liquid or solid fuels, alternative fuels, gaseous fuels (including hydrogen, natural gas, methane, ethane, propane, butane, etc.), automotive gasolines, diesel fuel oils, heavy diesel fuel oils, aviation gasoline, gas oils, fuel oils, aviation jet turbine oils, coal, coal oils, coal liquids, and the like. Industry specifications, including ASTM, IP, COST, DERD, MIL, AN, U.S. Clean Air Act, California Air Resources Board, and Swedish/European EPEFET standards, EU Standards, and other reported industry or government standards known in the art, and Criteria for Quality of Petroleum Products, J.P. Allison, 1973 (and subsequent editions), all hereby incorporated herein by reference.

NITROALKANES/NITROPARAFFIN

Other blending agents as contemplated herein include

nitroalkanes. Non-limiting examples include mononitroalkanes, arylnitroalkanes, polynitroalkanes, nitro-arenes, polynitro-arenes, aromatic nitro-compounds, polyaromatic nitro-compounds including derivative, homologue and analogue. Examples include nitromethane, nitroethane, nitropropane, nitrobutane, nitrohexane, nitroheptane, nitrobenzene, nitrotoluene, dinitrotolune. Acceptable concentrations are 1 to 2000 pprri, 10 to 500 ppm, 10 to 300 ppm, 50 to 100 ppm.

BIO-DIESEL

As contemplated within this disclosure bio-diesel shall include, but not be limited to: Methyl Soyate, Rapeseed Methyl Ester (RME), Methyl Tallowate, Methyl esters from lipid sources CAS Number: 67784-80-9. Bio-diesel is characterized generally but not required to have a boiling point at 760 mm Hg of less than 200°C, volatiles less than 2 % by Volume, insoluble in water, a specific gravity (H2 O=1) of 0.88, Vapour Pressure, mm Hg: <2, an evaporation Rate, Butyl Acetate=1: <1, a vapour Density, Air=1 :>1, being a pale yellow liquid, with mild odour. Variations are contemplated in the claims below.

METALS PRACTICE

In the practice of this invention, as set forth in the

aforementioned PCT Applications, contemplated metallics include all non-lead metals, metalloids, and non-metals (herein "metals" or "metallics"), their derivative compounds (organic or inorganic), whose combustion (product accomplishes primary object of vapor phase combustion, which is evidenced by a brilliant luminous reaction zone extending some distance from the metal's surface. Such combustion does not take place on the surface of the metal, or on and/or within the molten layer of oxide covering the metal, typical, of heretofore metallic combustion. Distinguishing vapor phase combustion is that its combustion is expansive with elevated exhaust velocities, and resultant metallic oxide particles are formed in the submicron range. Typically fuel economy, power output, exhaust emissions, combustion temperatures are materially improved.

Thus, a very wide range of acceptable metals and derivative compounds are contemplated. Group IA (alkali metals), IIA, (alkaline earths) elements, the transition elements/metals of group IIIb, IVb, Vb, VIb, VIIb, VIIIb [8, 9, 10], the elements of group Ib, IIb, IIIa, IVa (absent carbon) , and group Va, VIa, VIIa (elements are contemplated. Non-limiting examples include aluminum, boron, bromine, bismuth, beryllium, calcium, cesium, chromium, cobalt, copper, francium, gallium, germanium, iodine,

iron, indium, lithium, magnesium, manganese, molybdenum, nickel, niobium, phosphorus, potassium, palladium, rubidium, sodium, tin, zinc, praseodymium, rhenium, silicon, vanadium, strontium, barium, radium, scandium, yttrium, lanthanum, actinium, cerium, thorium, titanium, zirconium, hafnium, praseodymium, protactinium, tantalum, neodymium, uranium, tungsten, promethium, neptunium, samarium, plutonium, ruthenium, osmium, europium, americium, rhodium, iridium, gadolinium, curium, platinum, terbium, berkelium, silver, gold, dysprosium, californium, cadmium, mercury, holmium, titanium, erbium, thulium, arsenic, antimony, ytterbium, selenium, tellurium, polonium, lutetium, and astatine, including their organic and inorganic derivative compounds, which are capable of vapor phase combustion, are contemplated in the claims hereto and incorporated herein by reference. Applicant's metals, including derivative compound, may be organo-metallic or inorganic. Accordingly, the inorganic and organic compounds of CRC Handbook of Chemistry and Physics, Lide, 75th (1994-1995) and earlier editions, Ann Arbor, CRC Press; Sigma-Aldrich Chemical Directory, Aldrich Chemical Company (1997), Chemical Abstract Service (CAS), on line Registry File [1], American Chemical Society, Chemical Abstract Service, Ohio State

University, A Manual of Inorganic Chemistry, Thorpe, N.Y., Putnam & Son's (1896), Inorganic Materials, 2 ed., Ducan, N.Y. J.Wiley & Son (1996), Handbook of Inorganic Compounds, Perry, Phillips, CRC Press, Boco Raton, (1995), Inorganic Chemistry, Phillips, Williams, N.Y. Oxford University Press (1965-1966), Inorganic Materials Chemistry, D. Seneeta, G.E. R & D Center, N.Y., CRC Press (1997), Inorganometallic Chemistry, Fehlner, N.Y., Plenum (1992), Nontransition-Metal Compounds, Eisch, N.Y., Academic Press (1981), Metal & Metalloid Amides, Horwood, N.Y., Halsted Press (1980), Kirk-Othmer Encyclopedia of Chemical Technology, 2nd and subsequent editions, John Wiley & Sons (1963), Dictionary of Chemical Names & Synonyms, Howard, Neal, Lewis Publishers, Ann Arbor, (1992), Hawley's Condensed Chemical Dictionary, 12th Edition, Richard J. Lewis, Sr., Van Nostrad Reinhold Company, N.Y. (1993), Dictionary of Chemical Solubilities, Inorganic, Comey, MacMillian Press (1921), Solubilities of Inorganic and Metal Organic Substances, Seidell, N.Y., Van Nostrand (1940-1941), Solubility of Inorganic and Metal-Organic Compounds, Like, Princeton N.J., Van Nostrand (1958-1965), Organometallies (cite omitted), Organo Metallic Chemistry, F.G.A. Stone, Academic Press (1972 and subsequent years), Organo Metallic Compounds, 2 Ed, Michael Dub,

Springer-Verlag, New York Inc. (1966 Vol. 1 to 3, and subsequent volumes/supplments), Organo-metallic Compounds, Coates, Edward, New York, Wiley (1960), Comprehensive Organometallic Chemistry II (A Review of the Literature 1982-1994), Abel, Stone, Wilkinson, El Sevier Science Ltd (1995), Handbook of Organometallic Compounds, Kaufman, D. Van Nostranl Company Inc. (1961), Handbook of Organometallic Compounds, Hagihara, Kumanda, Okawars, W.A. Benjamin Inc (1968), Organometallic Chemistry, Mehrotra, Singh, John Wiley and Sons, (1991), Organometallic Chemistry, Chemical Society (1971 and all subsequent publications), London, Metal-Organic Compounds, American Chemical Society (1959 to present), Chemical Abstracts, American Chemical Society, Chemical Abstract Service, Ohio State University, .(From 1907 to present), Structure Reports 1913 to 1973 (Metals and Inorganic Compounds), International Union of Crystallography, Bohn, Scheltena & Hellema (volumes 1-40), The Merck Index, 12th Ed., Budavari, O'Neil, Merck Research Laboratories, N.J. (1996), which are capable of vapor phase combustion, together with said publications (including all related/subsequent editions, volumes, supplements, updates, or related publications) are incorporated herein by reference.

However, it is an object of this invention to ultilize

where possible those ECS metallics which are not nuerotoxic, especially where human ingestion is possible.

In the practice of this invention, cyclomatic compounds are particularly desireable. Non-limiting examples of cyclomatic compounds include compounds with one or more rings systems, including alicyclic or aromatic ring systems. Ring systems which may be wholely organic, wholely, inorganic, or heterocyclic. Such ring systems may include cyclic borons (borazoles), Cyclic silanes (silacyclobutane, 2, 4, 6, 8, ID-pentamethylcyclopentasilazane, cyclohexasilanes, cyclopropenyl silanes, etc.), cyclic nitrogens (pyrazoles, pyridines, pyrroles, piperazines, imidazals, etc.), cyclic, oxygens (benzoyls, furans, pyrans, e.g. tetrahydropyran, pyrones, dioxins, etc,), cyclic sulfurs (thiophens, dithiles, etc.) or other cyclic inorganics. Cyclomatic organic ring systems include saturated rings (cyclopropyl, cyclobutyl, cyclopentyl, cyclohexyl, cyclooctyl, etc.), unsaturated rings, rings with one or more multiple or double bonds (cyclohexadiene, cyclopentadiene, cyclotetraene, etc.), aromatic rings/cycloalkyl radicals (phenyl, benzyl, styryl, etc.), fused rings, fused aromatic rings (naphthls, naphthenates, etc.), fused ring with cyclopentadienyl moiety, rings containing

oxygenl or a hydroxyl (phenol, etc.). The disclosed metallic cyclomatics contained in Heterocyclic Chemistry, Katritzy, Boulton, Academic Press (1966 to 1997 all volumes), Benzenoid-rMetal Complexes, Zeiss, Wheatley, Winkler. The Ronald Press Co (1966), The Ring Index 2 Ed, Patterson, Capell, American Chemical Society, Reinhold Publishing Corp (1960 and subsequent editions), Ring Enlargement of Organic Chemistry, Hesse, VCH Publishers (1991), Rings, Cluster, and Plymers of Main Group Elements, Cowley, American Chemical Society (1983), which are capable of vapor phase combustion, together with said publications (including subsequent editions, volumes, or supplements), are incorporated herein by reference.

Desireable metal containing cyclomatic compounds are those with cyclic rings having high burning velocities. The higher the burning the velocity, generally the higher the preference. Generally larger rings have higher burning velocities compared to smaller rings. Thus, a cyclooctane ring is generally preferred over cyclohexane, which is preferred over a cyclobutane ring. Saturated rings are normally more preferred over unsaturated rings. The more saturated the ring the more preferred. Thus, cyclohexane is preferred over benzene. Ring systems where the metal is in turn attached to one or more

a hydroxyl, carbonyl, an alkyloxy radicals is generally preferred. Variations to this general rule are expected.

Non-limiting examples of desireable ring systems/complexes include: cyclohexane, cyclohexene, cyclopentane, cyclobutane, cyclopentadiene, phenyl, benzene, and naphthalene. More desireable are cyclohexane, cyclohexene, and cyclopentadienyl. It is contemplated each elemental metal of this invention can be employed in a cyclomatic compound.

Transition metal ring systems are well known in the art and highly desireable. See U.S. Patents Nos. 2,818,416, 3,127,351, 2,818,417, 2,839,552, 2,680,___; 2,804,468; 3,341,311, 3,272,606, 3,718,444), Canadian Patent #1073207, European Patent Application # 93303488.6, pages 6-8 (1993), incorporated herein by reference. As contemplated herein, ring system attachment may be direct or indirect. Attachment may be via molecular bond, ionic bond, coordination bond or other bond known in the art. Indirect attachment may be via one or more radical or element, or be via other bond as described below or known in the art. See The Chemistry of Organometallic Compounds, Rochow, Hurd, Lewis, New York, John Wiley & Sons, Inc. (latest edition), incorporated by reference.

One or more radicals (including cyclic radicals), side chains, saturated or unsaturated, may be attached to one or more locations on the ring, and/or to one or more locations of each metal. Thus, the metal may contain between one to as many radicals as available valence electrons (oxidation states) permit. See Handbook of Data on Organic Compounds 2ed, Weast, Grasselli, CRC (185).

Non-limiting examples of radicals, include organic or inorganic, saturated or unsaturated, or combinations thereof, including: hydrogen (hydride), hydroxyl, hydrocarbyl group radicals, including alkyl radicals (e.g. methyl, ethyl, propyl, issopropyl, butyl, isobutyl, sec-butyl, tert-butyl, amyl, pentyl, hexyl, etc.), alkyloxy radicals, various positional isomers thereof (e.g. 1-methyl-butyl, 2-methyl-butyl, 3-methyl-butyl, 1,1-dimethyl-propyl, 1,2-dimethyl-propyl, etc.), corresponding straight and branched chain isomers (e.g. hexyl, hepyl, octyl, nonyl; decyl, etc.), alkenyl radicals (ethyl, $/\backslash^{1}$-propenyl, $/\backslash^{2}$-propenyl, isopropenyl, etc.), corresponding branch chain isomers thereof, other isomers thereof (e.g. heptenyl, octenyl, nonyl, decenyl, etc.), alkenyloxy radicals, aryl radicals (e.g. phenyl, a-napthyl, b-naphthyl, a-anthryl, b-anthryl, etc.), aryloxy radicals,

including monovalent radicals of such aromatics (e.g. indene, isoindene, acenaphthene, flourene, phenanthrene, naphthacene, chrysene, pyrene, triphenylene, etc.), aralkyl radicals (e.g. benzyl, a-phenyl-ethyl, b-phenyl-ethyl, a-phenyl-propyl, etc.), aralkyloxy radicals, various positional isomers thereof (e.g. derivatives of 1-methyl-butyl, 2-methyl-butyl, 3-methyl-butyl, 1,1 dimethyl-propyl, etc.), corresponding alkyl derivatives of phenanthrene, flourene, acenapthene, etc., alkaryl radicals, (e.g. o-tolyl, m-tolyl, p-tolyl, o-ethylphenyl, etc.), arylalkenyl, cycloalkyl radicals (benzyl, etc.), cycloalkyloxy radicals, aliphatic radicals, mesityl. See generally Canadian Patent 1073207, pages 4-7, European Patent Application # 93303488.6, pages 6-8, 10/11/93), Handbook of Data on Organic Compounds 2 Ed, Weast, Grasselli, CRC 1985, CRC Handbook of Chemistry and Physics, 75th and earlier editions, sections re: "Nomenclature For Inorganic Ions and Radicals," "Organic Radicals and Ring Systems," Nomenclature of Inorganic Chemistry (Recommendations), Blackwell Scientific Publications, Offord 1990; Richer, J.C., Panico, R., and Powell, W.H. A Guide to IUPAC Nomenclature of Organic Compounds, Blackwell Scientific Publications, Offord 1993, Weast, R.C., and Grasselli, J.C., Handbook of Data on Organic Compounds, 2nd

Ed. CRC Press, Boca Raton, FL, 1989; incorporated by reference.

Hydroxyl, alkanol, alkanolamine, oxy and/or oxygen containing radicals, including derivatives of thereof and derivative of above radical are also contemplated. Non-limiting examples include hydroxy, methoxide, ethoxide, propoxide, isopropoxide, butoxide, isobutoxide, sec-butoxide, tert-butoxide, pentoxide, amyloxide, phenyloxidesperhydroxy, methoxy, methylol, methylenedioxy, ethoxy, ethylol, ethylenedioxy, enanthyl, propoxy, pro-prylol, propylenedioxy, isopropoxy, isopropylol, isopropylenedioxy, butoxy, butylenedioxy, butylol, iso-butoxy, iso-butylol, isobutylenedioxy, isobutyryl, sec-butoxy, sec-butylol, sec-butylenedioxy, tert-butoxy, tert-butylol, tert-butylenedioxy, butyryl, caproyl, capryl, caprylrl, pentoxy, pentylol, pentalenedioxy, amylol, amylenedioxy, phenoxy, phenylol, phenylenedioxy, phenyl-methoxy, diphenylmethoxy, benzoyl, benzyloxy, benzoxy, iso-benzoyl, napthoxy, napthylol, hexylol, hexamethylol, amylenedioxy, hexadecanoyl, heptanedioyl, hexylenedioxy, carbomethoxy, carbethoxy, carbobenzoxy, carbpropoxy, carbisopropoxy, carbutoxy, phenacyl, phenacylidene, propionyl radicals, methylenedioxyl, carbonyldioxy, etc., including derivatives,

homologes, analoges, and isomers thereof. Additional non-limiting oxygen containing radicals include acetyl, acetamido, acetoacetyl, acetonyl, acetonylidene, acrylyl, alanyl, B-alanyl, allophanoyl, anisyl, benzamido, butryl, carbonyl, carboxyl, carbazoyl, caproyl, capryl, caprylrl, carbamide, carbamoyl, carbamyl, carbazoyl, chromyl, cinnamoyl, crotoxyl, cyanato, decanoly, disiloxanoxy, epoxy, formamido, formyl, furyl, furfuryl, furfurylidene, glutaryl, glycinamido, glycolyl, glycyl, glyocylyl, heptadecanoyl, heptanolyl, hydroperoxy, hydroxamino, hydroxylamido, hydrazido/hydrazide, hydroxy, iodoso, isoccyanato, isonitroso, keto, lactyl, methacrylyl, malonyl, nitroamino, nitro, nitrosamino, nitrosimino, nitrosyl/nitroso/ nitrilo, oxamido, peroxy, phosphinyl, phosphide/phosphido, phosphite/phosphito, phospho, phosphono, phosphoryl, seleninyl, selenonyl, siloxy, succinamyl, sulfamino, sulfamyl, sulfeno, thiocarboxy, toluyl, ureido, valeryl radicals, etc., including derivatives, homologes, analoges, and isomers thereof.

Additional non-limiting examples of other radicals, include: acetimido, amidino, amido, amino, aniline, anilino, arsino, azido, azino, azo, azoxy, benzylidine, benzldyne, biphenylyl, butylene, iso-butylene, sec-butylene,

tert-butylene, cyano, cyanamido, diazo, diazoamino, ethylene, disilanyl, glycidyl, guanidino, guanyl, heptanamido, hydrazino, hydrazo, hypophosphite (hypophosphito), imido, isobutylidene, isopropylidene, silyl, silylene, methylene, mercapto, methylene, et,hylene, naphthal, napthobenzyl, naphthyl, naphthylddene, propylene, propylidene, pryidyl, pyrryl, phenethyl, phenylene, pyridino, sulfinyl, sulfo, sulfonyl, tetramethylene, thenyl, thienyl, thiobenzyl, thiocarbamyl, thiocarbonyl, thiocyanato, thionyl, thiuram, toluidino, tolyl, a-tolyl, -tolylene, a-tolylene, tosyl, triazano, ethenyl (vinyl), selenyl, trihydrocarbylamino, trihaloamino, trihydrocarbyl phosphite, trihalophosphine, trimethylene, trityl, vinylidene, xenyl, xylidino, xylyl, xylylene, 1,3-diene, hydrocarbyl radicals, etc., including derivatives, homologes, analoges, and isomers thereof. Thus, ring compounds or metals themselves may directly or indirectly contain one or more chelating radicals (e.g. carbonyl, cyano, etc.).

One or more of the above radicals may be attached directly or indirectly to another. Indirect attachment may be via one or more intermediate atom, including but not limited to carbon, nitrogen, oxygen, phosophorus, silicon, boron, sulfur, or another metal. Metallic compounds may have one or more non-ring

radicals attached. Besireable metals may for example have one or more alkyl, alkylene or similar radical attached to the metal, or one or more hydroxyl, carbonyl, alkyloxy, alkanol radicals, or combination thereof attached. Examples include

Other metallic compounds may have one or more ring systems attached directly or indirectly to a metal, with or without an attached non-ring radical to the metal.

One or more cyclic rings maybe attached, fused or indirectly attached together or linked together via one or more radicals, one or more atoms, including but not limited to carbon, nitrogen, oxygen, phosophorus, silicon, boron, sulfur, or a metal.

One or more metals may be attached to each other, for example hexamethyldisilane, which is a preferred metjillic. Indirect attachment herein includes attachment via one or more radicals, and/or one or more atoms, including but not limited, to carbon, nitrogen, oxygen, phosophorus, silicon, boron, sulfur, or another metal.

As contemplated herein said carbon, nitrogen, oxygen, phosophorus, silicon, boron, sulfur, or other metal atom, may be attached to itself or to another herein, one or more times, with each atom optionally having one or more hydrogen and/or

radical(s). Said attachment may be independent of attachment to any other, radical or metal, or may include an attachment to another radical or metal.

Likewise one or more cyclic rings may be attached directly to the metal, or indirectly via one or more non-ring radicals, and/or via one or more intermediate atoms, including but not ilimitied to carbon, nitrogen, oxygen, phosophorus, silicon, boron, sulfur, or another metal.

Thus, one or more metals may be attached at one, or up to every location possible on the ring system, directly and/or indirectly. Likewise, one or more ring systems may be attached at one, or up to every metal location possible, directly and/or indirectly.

A non-ring radical may be independently attached directly or indirectly to the metal, absent its attachment of a ring system. In the practice of this invention the attachment of one or more non-ring radical(s) to a metal, absent a ring system is expressly contemplated.

Contemplated oxygenated metallic compounds include metallic alkanols, ethers, ketones,.hydroxides, alkyloxy, including methoxy, dimethoxy, trimethoxy, ethoxy, diethoxy, triethoxy, oxalate, carbonate, dicarbonate, tricarbonate, and

similar structured compounds, including mixture thereof. For example trimethoxymethylsilane (as set forth below) is desireable. Metallic carbonates, including dimetallic carbonates, dimetallic dicarbonates, and the like, are also contemplated. It is contemplated these oxygenated metallic or organo-metallic compounds may be employed absent a dialkyl carbonate or other oxygenated ECS structure.

Likewise one or more non-ring radicals may be independently attached directly or indirectly to the ring system, absent attachment of a metal. An independent attachment of a metal may be via intermediate radical, one or more intermediate atoms, including but not limited to carbon, nitrogen, oxygen, phosophorus, silicon, boron, sulfur, or another metal.

A cyclic ring/radical/side chain may be indirectly attached to the metal through one of more atom, including but not limited to carbon, nitrogen, oxygen, phosophorus, silicon, boron, sulfur, or a metal. Indirect attachment via oxygen is contemplated but less desireable.

Cyclic rings may be attached to one or more non-ring radicals, atoms and/or ring systems prior to a direct or indirect attachment of the metal. For example,

[2-(cyclohexenyl)ethyl]triethoxysilane contains a ethyl radical attached to the cyclohexenyl ring, which is then attached to silicon. This is a preferred metallic structure.

Thus, cyclomatic compounds may contain one or more ring systems, optionally with one or more non-ring radicals attached thereto. Said ring(s) then may be attached directly or indirectly to a metal, with said metal in turn optionally attached directly or indirectly to a radical, with said radical being optionally a non-ring radical selected from one or more hydrogen, hydroxyl, alkyl, aryl, carbonyl, alkanol, alkanolamine, alkyloxy, oxy or oxygen containing radical. Non-limiting examples include methylcyclopentadienyl manganese tricarbonyl, [2-(cyclohexenyl)ethyl]triethoxysilane, and cyclohexenyl dimethoxymethylsilane.

Another class of desireable metallics include metal hydrides or metallic hydryls. Examples of metallic hydryls include sodium hydride, lithium hydride, aluminum hydride, aluminum borohydride, boron hydride, boron anhydride, beryllium borohydride, lithium borohydride,lithium aluminum hydride, lithium borohydride, sodium borohydride, transition-metal hydrides, transition-metal carbonyl hydrides,

transition-metal cyclopentadienyl hydrides, and mixture. Those hydrides known in the art and those disclosed in Metal Hydrides, Bambakidis, New York, Plenum Press (1981), Boron Hydride Chemistry, Muetterties, New York, Academic Press (1975), which accomplish primary vapor phase combustion object of this invention, are contemplated in the claims below and incorporated herein by reference.

Organometallic nitrosyls are also desireable. See for example Metal Nitrosyls, Richter-Addo, Oxford University Press, U.K. (1992), incorporated by reference. Flammable metal napthenates or metals derivatives of napthenic acid are desireable, including potassium naphthenate.

Alkali/alkali earth metal carbonates (including organic alkyl aryl carbonates), alkali/alkali earth formates, alkali/alkali earth etherates, alkali/alkali earth alkalates, alkali/alkali earth esters, multi-metal alkyl/alkyl earth carbonates, or carbonates including those with a hydrogen (e.g. L1HCO3, Na2CO3, NaHC03, MnC03, MgCO3, CaCO3, CaMg(CO3)2, etc,.), alkali metal carbonates, and other metal carbonates (e.g. AgCO3, T12CO3, etc.), including organic derivatives are contemplated. Contemplated salts also include acid salts containing replaceable hydrogen. Double oxides and hydroxides

are also contemplated.

Transition metals and their known cyclomatic compounds, including carfoonyl compounds are expressly contemplated. See Fundamental transition Metal Organometallic Chemistry, Lukehart, Monteray, Calif, Brooks/Cole (1985), Transition Metal Compounds, King, New York, Academic Press (1965), Transition-Metal Orqanometallic Chemistry, King, New York, Academic Press (1969), Fundamental Transition Metal Orqanometallic Chemistry, lukehart, Monterey, Ca., Brooks/Cole (1985), incorporated herein by reference. A preferred cyclomatic transition metallic is MMT.

Contemplated herein are non-transition-metal compounds known in the art. See Nontransitiori-Metal Compounds, Eisch, New York, Academic Press (1981), incorporated by reference. Non-transition metal compounds that accomplish primary object of vapor phase combustion are contemplated in the claims below and incorporated herein by reference.

Likewise known metallocenes are contemplated. Non-limiting examples include alkylmetallocenes, arylmetallocenes, including dicyclopentadienyl-metal with the general formula (C5H5)2M, dicyclopentadienyl-metal halides with the general formula (C5H5)2MX1-3,

monocyclopentadienyl-metal compounds with the general formula C5H5MR1-3, where R is CO, NO, halide group, alkyl group, etc. Non-limiting examples include napthacenes, metallocene,.ferrocene, methylferrocene, cobaltocene, nickelocene, titanocene dichloride, zirconocene dichloride, uranocene, decamethylferrocene, decamethylsilicocene, decamethylgermaniumocene, decamethylstannocene, decamethylphosocene, decamethylosmocene, decamethylruthenocene, decamethylzirconocene, silicocene, decamethylsilicocene, etc., are also contemplated. Metallocenes that accomplish primary object of vapor phase combustion are contemplated in the claims below and incorporated herein by reference. See also Hawley's Condensed Chemical Dictionary 12th ed, Lewis, Van Nostrand Reinhold Company, New York (1993), also incorporated by reference.

Carbonyl compounds are expressly contemplated. A limited number of examples include decacarbonyl dimanganese, (acetylacetonato)dicarbonylrhodium. See for example Carbonylation: Direct Synthesis of Carbonyl Compounds, H.M. Colquhoun, Plenum Press (1991), incorporated herein by reference.

As noted above, non-limiting non-leaded simple

binary/ternary metallic compounds, including binary/ternary and higher metallic salts, acid salts, including those with replaceable hydrogen, etc.j are contemplated. Hydroxy acids, perchlorates, sulfates, nitrates, carbonates, hydroxides, methylates, ethylates, propylates, and others, are also contemplated. Non-limiting examples include potassium[1] nitrite, sodium nitrite, lithium nitrite, and hexamethylphosphoric triamide.

It is also within the scope and practice of this invention to employ oxygenated containing ECS metallic compounds, including oxygenated organo metallic compounds, which are metallic alcohols, alkanolamines, ketones, esters, ethers, carbonates, and the like, which are themselves ECS compounds, in hydrocarbon fuels with or absent additional dialkyl carbonate.or other ECS structure. Those metallics are incorporated herein by reference. Additionally, this invention contemplates one or more similar organo oxygen containing metallics, including mixture, with or without an ECS compound, to act as neat "stand alone" fuel. Thus, it is an express embodiment to use metallic compounds alone, as singular means of enhancing fuel combustion. However, it is preferred the metallic be added to the ECS oxygenate, preferably MTBE, ETBE,

DMC, or Ethanol, optionally a co-fuel, an oxidizer, catalyst, and/or a hydrocarbon. The contemplated oxidizers of this invention are set forth in the aforementioned PCT applications. Oxidizers, including those employed in rocket propulsion, which are known in the art are incorporated by reference.

It is also within the practice of this invention to employ a metallic compound, including homologue, analogue, isomer, or derivative thereof, having a structure or structure similar to $M-R^n$, $R^n-M-M-R^n$, $R^n-M-Q-M-R^n$, $R^n-N1-Q-M-R^n$, $R^n-M-R-M-R^n$, wherein M is one or more non-leaded metal(s), metalloid(s), or non-metal element(s), and R is one or more hydrogen, cyclic ring system/radical/side chain(s), and/or non-ring radical/side chain(s) as provided herein above, including but not limited to alkyl, aryl, alkyloxy, alkylanol (alkanol), hydroxyl, aryloxy, polyalkyl, polyaryl, polyalkyloxy, polyalkylanol, polyaryloxy, polyhydroxyl radicals. R is one or more cyclic ring system/radical/side chain(s), and/or non-ring radical/side chain(s) as provided herein. If R is greater than 1, then subsequent R's may be same or different radical, etc. R also be a single radical or one radical attached to one or more radicals, "n" is an interger ranging from 1 to the number of valence electrons (or common oxidation states) available of

M. Q is an atom having a minimum oxidation available of 2, including but not limited to carbon, nitrogen, oxygen, phosophorus, silicon, boron, sulfur, or a differing metal than M. Q^1 is an atom with a minimum available oxidation state of 2, including but not limited to carbon, nitrogen, oxygen, phosophorus, silicon, boron, sulfur, or a differing metal than M, also containing one or more radicals.

Additional oxygenated-organo or oxygenated metallic structure includes M1-O(CO)O-M2, wherein M1 or M2 are the same or different metal or element. M1 may be a double valence cation, wherein M2 is absent from above structure, unless additional carbonate is included. Preferred M valences are 1 or 2. M valences or multiple M1M2 combinations having combined valence greater than two are acceptable. In which case, additional carbonate structure would be added, e.g. $CaMg(CO3)2$.

In the immediate structure above, M1/M2 valence's may be greater than one, wherein excess valence is occupied by same or additional metal (element), and/or wherein M1 or M2 are substituted for a single or double bond oxygen, and/or by one or more radicals. M1 or M2 also may be substituted for single bond oxygen, or nitrogen, and/or by one or more radicals, including methyl, hydrogen, hydroxy, ethoxy, carbethoxy,

carbomethoxy, carbonyl, carbonyldioxy, carboxyl, methyoxy, isonitro, isonitroso, or methylenedioxyl radical. Non-limiting examples include carbonates of lithium [Li2O2(CO)], ammonium manganese, potassium [K2O2(CO)], sodium, calcium, cesium, copper, rubidium, lithium hydrogen, sodium hydrogen, potassium hydrogen, potassium sodium, magnesium, and the like.

It is contemplated that C2 to C8 metallic ethers, C2 to C4/C5/C6 metallic ethers being more desireable, will be used as metallic structure in this invention. For example, M'1-CH2-CH2-O-CH2-CH2-M'2 structure is contemplated wherein M'1 and M'2 may be same or different metallic or wherein one M'1 or M'2 may be hydrogen, or other atom, or radical with one available valence.

Other contemplated structure include metallic ketones, esters (esters of boric acid), alcohols, acids, and the like. Non-limiting examples include M1-C-OH3-R, wherein M1 is one or more metallic comprising valence of 3 or greater, and R is radical, whereby resulting structure is ketone, ester, acid, alcohol, or ether. Other structure include M1-C2O4, wherein M'1 has a valence of 2. M1-C-C-0-C-C-M2 structure is also contemplated wherein M1 and M2 may be same or different metallic

or wherein M2 may be hydrogen or atom of one valence. Other structure includes RO-M, where RO is an alkanol and M is a metal. Similar structure is contemplated for M have available valence greater than 1.

As in the case of ECS oxygenates, the carbon chains of organo-ECS metallics are preferably shorter than longer. For example/, a 5 carbon atom straight chain, which is immediately antecedent to a metal atom, is less preferred than a 4 carbon straight carbon atom chain. A three carbon chain is more preferred over a 4 carbon atom chain, arid a two more preferred than a 3. Generally the longer the chain, the less desireable. An exception would be where the chain length and character positively increases burning velocity.

Where there is an intermediate oxygen or nitrogen atom between the carbon chain and the metal atom, particularly if the oxygen or nitrogen atom is attached to the metal, a chain of two carbon atoms is generally preferred over a single carbon atom. In such cases an ethyl radical is generally preferred over propyl, which is preferred over butyl radicals. Branch chains are preferred over straight chains with the same number of carbon atoms.

Chains greater than 10 carbon atoms long are less

desireable and not normally contemplated. Thus, the oil soluble metal soap of aluminum stearate, which has three separate 17 carbon chains each connected to the aluminum atom through an intermediate oxygen atom [CHs (CH2) isCOO] sAL, is not an effective ECS metallic and is excluded. Poorly combustible long chain metal soaps are excluded from the ECS metallics contemplated herein. Also excluded is cetyl pyrdrium chloride.

Non limiting examples of lithium derivative compounds of this invention, include: lithium bis (dimethylsilyl-) amide, lithium bis(trimethylsilyl)amide, oxamic acid, P-aminosalicylic acid lithium salt, lithium salt 5-nitroorotic acid, lithium D-gluconate, lithium hexacyanoferrate(ill) (Li3Fe (CN) 6) , lithium diphenylphosphide, lithium acetate, lithium acetate acid, lithium salt acetic acid, lithium acetamide, lithium anilide, lithium azide, lithium benzamide, lithium antimonide, lithium orthoarsenate, lithium orthoarsenite, lithium meta-arsenite, lithium diborane, lithium pentaborate, lithium dihydroxy diborane, lithium borohydride, lithium cadium iodide, lithium chloride, lithium calcium chloride, lithium carbide, lithium carbonate, lithium hydrogen carbonate, lithium carbonate, alkyl lithium carbonates, lithium methyl carbonate, lithium ethyl carbonate,

lithium carbonyl, lithium cobalt (II) cyanide, lithium cobalt (III) cyanide, lithium cobaltinitrite, lithium cynomanganate (II), lithium cynomanganate .(III) , lithium citrate, lithium ferricyanide, lithium ferrocyanide, lithium formate, lithium hydride, lithium hydroxide, lithium manganate, lithium permanganate, lithium methionate, lithium napthenate, lithium nitride,, lithium nitrate, lithium nitrite, lithium nitrobenzene (e.g. lithium-p-nitrobenzene), lithium nitrophenoxide/lithium etherate, lithium chromate/ lithium oleate, lithium oxalate, lithium oxalatoferrate (II), lithium oxa.latof errate (III), lithium monoxide, lithium oxide, lithium peroxide, .lithium mono-orthophosphate, lithium hypophosphite, lithium orthophosphite, lithium hydroxoplumbate, lithium rhodium cyanide, lithium selenide, lithium selenite, lithium selenocynate, lithium selenocyanoplatinate, lithium disilicate, lithium metasilicate, lithium sodium carbonate, lithium sodium ferricyanide, lithium hydroxostannate, lithium disufide, lithium hydrosulfide, lithium pentasulfide, lithium tetrasulfide, lithium trisulfide, lithium telluride, lithium thioarsenate, lithium thioarsenite, lithium trithiocarbonate, lithium thiocyariate, lithium amide, lithium salt

(E,E)-2,4-hexadienoic acid, dilithium fluorophosphate, dilithium fluorophosphite, trilithium phosphate, trilithium .phosphite, lithium perchlorate, propanoic acid lithium salt, lithium formate, lithium cyanate, lithium hexacyanocobaltate (III), lithium hypophosphite, lithium hexaflurorsilicate, lithium nitroprusside, lithium phenoxide, lithium phosphate (dibas,ic, monobasic, tribasic) , lithium salicylate, lithium selenide, lithium tetracyanonickelate (II), lithium tetrafluoroborate, lithium xanthogenate, lithium -p-aminobenzoate, lithium copper ferrocynanide, lithium cupric ferrocyanide, lithium hexafluorophosphate, lithium hexanitricobaltate III, lithium naphthenate, lithium -B-naphthoxide, lithium polysulfide, lithium -sodium phosphate, lithium stearate, lithium sulfide, lithium sulfite, lithium sulfate, lithium thiocyanate, lithium xanthate, lithium fluorosilicate, N-lithiumethylenediamine, oxalic acid dilithium salt, lithium beta-hydropyruvic acid, lithium.1,1-dimethylurea, lithium 1,1-diethylurea, lithium 1,1-diepropylurea, lithium xanthate, lithium ethylxanthate, lithium methylxanthate, lithium salt thiophenol, lithium triphenyltnethyllithium, methyllithium, ethyllithium, lithiumethynyl(acetylide), propyllithium, isopropyllithium,

butyllithium, isobutyllithium, secbutyllithium, tertbutyllithium, pentalithium, hexyllithium, heptalithium, amyllithium, isoamyllithium, benzyllithium, dimethylbenzyl-lithium, tolyllithium, dodecyllithium, eyelopentadienyllithium, methylcyclopentadienyllithium, cyclohexyllithium, lithiumheptyl, lithiumdodecyl, lithium tetradecyl, lithium hexadecyl, lithium octadecyl, phenyllithium, lithium o-tolyl, lithium m-tolyl, lithium p-tolyl, lithium-p-chlorophenyl, lithium p-bromophenyl, lithium o- anisyl, lithium m-anisyl, lithium p-anisyl, lithium diethoxyphenyl, lithium dimethoxyphenol, lithium m-cumyl, lithium p-ethoxyphenyl, lithium m-dimethylaminophenyl, lithium 9-flourene, lithium a-napthyl, lithium b-napthyl, lithium p-phenylphenyl, lithium 9-phenylanthryl, lithium 9-anthryl, lithium 9-methyl-phenanthryl, lithium pyridyl, lithium 2-pyridyl, lithium 3-pyridyl, lithium 6-bromo-2-pyridyl, lithium 5-bromo-2-pyridyl, lithium dibenzofuryl, lithium 3-quinoyl, lithium 2-lepidyl, lithium triphenylmethyl, lithium 2,4,6-trimethylphenyl, lithium 2,4,6-triisopropylphenyl, lithium 2,3,5,6-tetraisopropylphenyl, lithium tetrabutylphenyl, thiophenedilithium, toluenedilithium,

dipheny-lethylenedilithium, lithiumamylethynyl, lithiumphenyl-ethynyl, lithiummethoxybromophenyl, lithium phenylisopropyl, lithium tetraphenylboron, lithium tetramethylboron, lithium a-thienyl, lithium m-trifluoromethylphenyl, phenylethynyl1i thium, 3 -furyl1ithium, phenylisopropyllithium, dibenzofuranyllithium, lithium dimethylbenzyl, lithium selenocyanate, lithium trimethyl-silanolate, diphenylphosphide, lithium benzoate, lithium tert-butyl carbonate, lithium azide, di-lithiumcyanamide, lithium cyanide, lithium dicyanamide, cyclohexanebutyric acid lithium salt, cyclohexane acid lithium salt, cyclopentadientyllithium, lithium tri-tert-butoxyaluminum hydride, lithium triethyl-borohydride, lithium trimethyl-borohydride, lithium tripropyl-borohydride, lithium triisopropylborohydride, lithium tributylborohydride, lithium triisobutylborohydride, lithium tri-sec-butylborohydride, lithium tri-tert-butylborohydride, lithium trisiamylborohydride, lithium chlorate, lithium tert-butoxide, lithium sec-butoxide, iso-butoxide, lithium antimonate, lithium diphenylphosphide, lithium bis(trismethylsilyl) amide, trilithium phosphite, lithium selenocyanate, lithium tri-sec-butylborohydride, lithium

triethylsilanolate, lithiumthiocyanate, lithium acetylide, lithium chlorate, lithium salicylate, lithium di-lithium tetracarbonylferrate, lithium tetraphenylborate, lithium triethylborohydride, lithium triacetoxy-borohydride, lithium triphenylborane, lithium hydroxide, lithium diphenylphosphide, lithium methoxide, lithium ethoxide, lithium tri-sec-butylborohydride, tri-tert-butylborohydride, lithium triethylborohydride, lithium triphenylborohydride, lithium trisiamylborohydride, lithium metavanadate, lithium cyclohexanebutyrate, lithium hexachloroplatinate, lithium thiocyanate, lithium selenocyanate, lithium cyanate, lithium floride, lithium hexafluoroantimonate, lithium hexafluoroaluminate, lithiumaluminate, lithiumaluminum-tri-tert-butoxide, lithium hexafluoroarsenate, lithium hexafluorosilicate, lithium hexacyanocobalt(II)ferrate(II), lithium ferrosilicon, dilithiumhexacyanocobalt (II) ferrate (II), lithium hexafluorotitanate, lithium hexafluorozirconate/ lithium hexahydroxyantimonate, lithium hexachlororuthenate, lithium hexachlbropalladate, lithium formate, lithium tetracyahbnickelate, lithium tetrafluoroaluminate,,lithium tetrafluoroborate, lithium thioacetate, L-glutamic acid

monolithium salt, fumaric acid lithium salt, oxamic acid lithium salt, lithium salt diphenyl-phospane, P-aminobenzoic lithium salt, aminobenzole acid lithium salt, alpha-napthaleneacetic acid lithium salt, dilithium salt 2 , 6-naphthalenedicarbox^lic acid, lithium cyclcohexanetherate, lithium phthalimide, P-aminosalicylic acid lithium salt, lithium salt 3,5-dimethylcyclohexyl sulfate, indolebutyric acid lithium salt,indole-3-butyric acid lithium salt, diphenylphosphide, lithium dimethyl-silanolate, lithium, triethylborohydride, lithium propoxide, lithium isopropoxide, lithium butoxide, lithium sec-butoxide, lithium pentoxide, lithium tert-pentoxide, lithium hydrogenphthalate, lithium oxalate, lithium hydrogensulfate, monolithium acetylenedicarboxylic acid, lithium pyrophosphate, lithium dihydrogenphosphate, lithium hexoate (lithium salt hexoic acid), lithium diphenylphosphide, lithium trimethylsilonalate, lithium phthalic acid, P-aminobenzoic acid lithium salt,monolithium L-aspartic acid, tetraphenyldilithium (C6H5) 2CLi2C (C6H5) 2, lithiumethylphenyl (LiCH2C6H5), lithium bromate, lithium hydrogenphospate, monlithium salt D-shaccharic acid, Dl-asparatic lithium salt, (R)-alpha-hyroxymethylaspartic acid lithium salt, lithium

fluoride, lithium iodate, lithium salt ethyl malonate, lithium thioacetate, lithium phenol, lithium salt aminobenzoic acid, lithium aminophenol salt, lithium cyclohexenol, lithium methylcyclohexenol, lithium cyclopropanol, lithium methylcyclopropanol, lithium cyclobutanol, lithium methylcyclobutanol, lithium methylcyclopentanol, lithium cyclopentanol, lithium cyclohexenol, lithium methylcyclohexenol, lithium dimethyl-cyclohexenols (e.g. lithium 3,5-dimethylcyclo-hexanol, lithium 2,3-dimethylcyclohexanol, lithium 2,6-dimethylcyclohexanol, lithium 2,5-dimethyleyelohexanol, 3,5-dimethylcyclohexanol), lithium o-ethylxanthic acid, monolithium salt 2-ketoglutaric acid, dilithium salt, ketomalonic acid, lithium salt lactic acid, dilithium thiosulfate, lithium antimony tartrate, lithium di-chloroacetate, lithium dimethylacetate, lithium diethylacetate, lithium dipropylacetate, lithium metaborate, lithium tetraborate, lithium tetrachlorocuprate, lithium acetoacetate, lithium diisopropylamide, lithium diethylamide, lithium dimethylamide, lithium bis(dimethyl-silyl)amide, dilithium, phthalocyanine, dilithiumtetra-bromocuprate, dilithium tetrabromonickelate, dilithiumtetra-chloromanganate, dilithiumbutadiyne, lithium

cyclopentadienide, lithium-dicyclohexylamide, lithium diethylamide, lithium dimethylamide, lithium dipropylamide, lithium diisopropylamide, lithium thexylborohydride, lithium tri-tert-butoxyaluminohydride, lithium trimethyl-silyl)acetylitie, lithium triethylsilyl)-acetylide, lithium tris t(3-ethyl-3-pentyl)oxy]aluminohydride, (phenylethynyl)lithium, 2-thienyllithium, lithium diethyldihydro-aluminate, lithium dimethyldihydroaluminate, lithium aluminum hydride, lithium bifluoride, lithium biphenyl, lithium bis-elenite, lithium bis(2-methoxyethoxy)-aluminum hydride, lithium bismuthate, lithium borate, lithium chlorite, lithium cobaltnitrite, lithium cyanoborohydride, lithium cyclopentadienide, lithium dicyanamide, lithium hexametaphosphate, lithium hexanitro-colbaltate, lithium hydrogenphosphite, lithium hydrogenselenite, lithium hydrogensulfite, lithium hydrosulfite, lithium hypochloride, lithium metaarsenite, lithium metabisulfide, lithium metaperiodate, lithium methacrylate, lithium nitrbferricyanide, oxybate, lithium pentamethylcyclo-pentadienide, lithium phenolate, polyphosphate, lithium polypho-sphite, lithium propionate, lithium pyrophosphate, lithium selenate, lithium selenite,

lithium tetrachloroaluminate, lithium thiomethoxide, lithium thiosulfate, lithium thiosulfide, lithium thiosulfite, lithium triactoxyborohydride, lithium trimethylsilonate, lithium triethylsilonate, lithium tris(1-pyrazoly)borohydride, including analogues, homologue, isomers and derivatives thereof. See Lithium Chemistry: A Theorical and Experimental Overview Sapse, Schleyer, John Wiley & Sons, N.Y. (1995), incorporated herein by reference. Non limiting examples of the boron derivative compounds, of this invention include: alkyl boron compounds, aryl boron compounds, 1,3,2-benzodioxaborole, diisopropoxymethylborane, ethylborane, diethylborane, diemthylborane, dicyclohexyl-borane, boric acid esters (e.g. borate ester, dimethyl borate, di-n-butyl borate, dicyclohexyl borate, didodecylborate, di-p-cresyl borates), phenylboronic acid,. 2-phenyl-1,3,2-dioxborinane, pyrrolyboranes (e.g. 1-pyrrolyborane, 2-pyrrolyborane), tetrabutylammonium borohydride, tetramethylammonium borohydride, tetraisoproplyammonium borohydride, tetrapropylammonium borohydride, tetraethylammonium borohydride, tetraisobutylammonium borohydride, tetra-tert-butylammonium borohydride, tetra-sec-butylammonium borohydride, tetrabutylammonium cyanoborohydride, tetramethylammonium

cyanoborohydride, tetraisoproplyammonium cyanoborohydride, tetrapropylammonium cyanoborohydride, tetraethylammonium cyanoborohydride, tetraisobutylammonium cyanoborohydride, tetra-tert-butylammonium cyanoborohydride, tetra-sec-butylammonium cyanoborohydride, tetramethylammonium tri-acetoxyborohydride, thiopheneboric acid, 2-thiopheneboric acid, 3-thiopheneboric acid, tolylboronic acid (e.g. o-tolylboronic acid, p-tolylboronic acid, m-tolylboronic acid), tributoxyborane, tributylborane, tri-sec-butylborane, tri-tert-butylborane, tributylborate, tri-tert-butylborate, trimethoxyboroxine, trimethylamineboran, trimethylborate, trimethylboroxine, trimethylborazine, trimethylene borate, triphenylborate, triphenylborane, tribenzyl borate, borate, trisiamylborane, tris(2-methoxyethyl)borate, boron hydride, lithium borohydride, sodium borohydride, boron hydrate, boron hydride, boron anhydride, triethylboron (C2H5)3, decaborane, borazoles, aluminimum borohydride, beryllium borohydride, lithium borohydride, hexamethyldiamineborane (CH3)3NBH(CH3)3), (CH3)2BI, berylliumborohydride (Be(BH4)2), trimethoxytriborate (BO)3(OCH3)3, C4H9B(OH)2, Al(BH4)2, Be(BH4)2, LiBH4, B(OC2H5)3, B(OCH3)3, trimethoxytriborane,

3-bromophenylboronic acid, trimethoxy borate, triethoxy borate, triproxyborate, tributoxyborate, triisobutoxyborate, tri-tert-butoxyborate, tri-sec-butoxyborate, tri-phenoxyborate, tri-phenoxyboroamine, tri-phenoxyborane, phenylboronic acid, benzylboronic acid, cylohexylboronic acid, cylohexenylboronic acid, cyclopentylboronic acid, methylphenylboronic acid, methylcylohexylboronic acid, methylcyclopentylboronic acid, methylbenzylboronic acid, dimethylphenylboronic acid, dimethylcylohexylboronic acid, dimethylcyclopentylboronic acid, dimethylbenzylboronic acid, diphenylboronic acid, dibenzylboronic acid, dicylohexylboronic acid, dicylohexenylboronic acid, dicyclopentylboronic acid, methyldiphenylboronic acid, bis-[(methyl)cylohexyl]boronic acid, bis[(methyl)cyclopentyl]boronic acid, bis[(methyl)benzyl]boronic acid, bis[(dimethyl)phenyl]-boronic acid, bis[(dimethyl)cylohexyl]boronic acid, bis[(dimethyl) cyclopentyl] boronic acid, bis[(dimethyl)benzyl]boronic acid, phenylboroncarbonyl, benzylboroncarbonyl, cylohexylboroncarbonyl, cylohexenylboroncarbonyl, cyclopentylboroncarbonyl, methylphenylboroncarbonyl,

methylcylohexylboroncarbonyl, methylcyclopentylboroncarbonyl, methylbenzylboroncarbonyl, phenylboronic acid carbonyl, benzylboronic acid carbonyl, cylohexylboronic acid carbonyl, cylohexenylboronic acid carbonyl, cyclopentylboronic acid carbonyl, methylphenyl-boronic acid carbonyl, methylcylohexylboronic acid carbonyl, methylcyclopentylboronic acid carbonyl, methylbenzylboroncarbonyl, dimethylphenylboroncarbonyl, dimethylcylohexylboroncarbonyl, dimethyl-cyclopentyl-boroncarbonyl, dimethylbenzylboroncarbonyl, diphenylboroncarbonyl, dibenzylboroncarbonyl, dicylohexylboron-carbonyl,dicylohexenylboroncarbonyl, dicyclopentylboroncarbonyl, methyldiphenylboroncarbonyl, di[(methyl)cylohexyl]boroncarbonyl, di[(methyl)cytlopentyl]boroncarbonyl, di[(methyl)benzyl]boroncarbonyl, di[(dimethyl)phenyl]boroncarbonyl, di[(dimethyl)cylo-hexyl]boroncarbonyl, di[(dimethyl)cyclopentyl]boroncarbonyl, di[(dimethyl)benzyl]boroncarbonyl, phenylboromethoxide (phenylborodimethoxide C6H5B (OCH3) 2) , benzylboromethoxide, cylohexylboromethoxide, cylohexenylboromethoxide,

cyclopentylboro-methoxide, methylphenylboromethoxide, methylcylohexylboro-methoxide, methyl-cyclopentylboromethoxide, methylbenzyl-boromethoxide, methylphenylboromethoxide, dimethylphenylboromethoxide, methylcylohexylboromethoxide, dimethylcylohexyl-boromethoxide, methylcyclopentylboromethoxide, dimethylcyclopentylboromethoxide, methylbenzylboromethoxide, dimethylbenzylboromethoxide, diphenylboromethoxide, dibenzylboromethoxide, dicylohexylboromethoxide, dicylohexenylboromethoxide, dicyclopentylboromethoxide, di (methylphenyl) boromethoxide, di (methylcylo-hexyl)boromethoxide, di(methylcyclopentyl)boromethoxide, di(methylbenzyl)boromethoxide, di(dimethyl-phenyl)boromethoxide, di(dimethylcylohexyl)boromethoxide, di(dimethylcyclopentyl)boromethoxide, di(dimethylbenzyl)boromethoxide, phenylboroethoxide (phenylborodiethoxide C6H5B(OCH3)2), benzylboroethoxide, cylohexylboroethoxide, cylohexenylboroethoxide, cyclopentyl-boroethoxide, methylphenylboroethoxide, methylcylohexylboro-ethoxide, methylcyclopentylboroethoxide,

methylbenzyl-boroethoxide, methylphenylboroethoxide, dimethylphenyl-boroethoxide, methylcylohexylboroethoxide, dimethylcylohexylboroethoxide, methylcyclopentylboroethoxide, dimethylcyclopentyl-boroethoxide, methylbenzylboroethoxide, dimethylbenzyl-boroethoxide, diphenylboroethoxide, dibenzylboroethoxide, dicylohexylboroethoxide, dicylohexenylboroethoxide, dicyclopentylboroethoxide, di(methylphenyl)boroethoxide, di(methylcylohexyl)boroethoxide, di(methyl-cyclopentyl)boroethoxide, di(methylbenzyl)boroethoxide, di(dimethylphenyl)boroethoxide, di(dimethyl-cylohexyl)boroethoxide, di(dimethylcyclopentyl)boroethoxide, di(dimethylbenzyl)boroethoxide, phenylboric acid, benzylboric acid, cylohexylboric acid, cylohexenylboric acid, cyclopentylboric acid, methylphenylboric acid, methylcylohexylboric acid, methylcyclopentylboric acid, methylbenzylboric acid, dimethylphenylboric acid, dimethyl-cylohexylboric acid, dimethylcyclopentylboric acid, dimethylbenzylboric acid, dibenzylboric acid, dicylohexylboric acid, dicylohexenylboric acid, dicyclopentylboric acid, methyldiphenylboric acid,

bis(methylcylohexyl)boric acid, bis[methylcyclopentyl]boric acid, bis [methylbenzyl] boric acid, bis [dimethyIphenyl] boric acid, bis[dimethylcylohexyl]boric acid, bis[dimethylcyclopentyl]boric acid, bis[dimethylbenzyl]boric acid, aminophenylboronic acid,3-aminophenylboronic acid, diborane, tetramethoxydiborane, tetraethoxydiborane, boric acid, borazine, borocarbonate, borane-tert-butylamine, tetraethylammonium borohydride, tetraethylammonium tetrafluoroborate, tetrapropylammonium tetrafluoroborate, naphthylboronic acids (e.g. 1-naphthylboronic acid, 2-naphthylboronic acid, 3-naphthylboronic acid, 4-naphthylboronic acid), methylnaphthlboronic acid, biphenylboronic acid, carborane, cyclohexylamine diborane, methylbenzeneboric acid, dimethylbenzeneboric acids (e.g. 3,5-dimethylbenzeneboric acid), hexadecaneboronic acid, tetreadecaneboronic acide, phenylethylboroamine, methylborazine, dimethylborazine, trimethylborazine, ethylborazine, diethylborazine, triethylborazine, carboborazine, dicarboborazine, tricarboborazine, triisopropoxyboroxine, tripropoxyboroxine, trimenthyl borate, trimenthyl borine, trimenthyl borane, trimethallyl borate, trimethallyl borine, tripentyl borate, tripentyl borine,

tripentyl borane, trimethyl borate, trimethylborine, triethylborine, triethylborane, triethylborate, tripropylborane, tripropylborine, tripropylborate (tripropoxyborane) , triisopropylborane, triisopropylborate, triisopropylborine, tri-iso-butylborane, tri-iso-butylborate, tri-sec-borane, tri-sec-borate, tri-sec-borine, tributyl borate, tributyl borine, tributyl borane, tri-tert-butyl borate, tri-tert-butyl borine, tri-tert-butyl borane, triphenyl borate, triphenyl borane,, tricyclohexylborate, tricyclohexylborane, dimethyl boric acid, diethylboric acid, dipropylboric acid, diisopropylboric acid, di-iso-butylboric acid, di-sec-boric acid, dibutylboratic acid, di-tert-butylboric acid, diphenylboric acid, dicyclohexylboric acid, boron tribromide, sodium tetrafluoroborane, sodium trimethylborohydride, triethylborohydride, sodium tripropylborohydride, sodium triisopropylborohydride, sodium tributylborohydride, sodium triisobutylborohydride, sodium-tert-butylborohydride, sodium-sec-butylborohydride, sodiumphenylborohydride, potassium tetrafluoroborane. potassium trimethylborohydride, triethylborohydride, potassium tripropylborohydride, potassium triisopro-pylborohydride, potassium

tributylbprohydride, potassium triisobutylborohydride, potassium-tert-butylborohydride, potassium-sec-butylborohydride, potassium phenylborohydride, butylboronic acid, sodiumborohydride, methyldichloroborane, ethyl dichloroborane, propyldichloroborane, isopropyldichloroborane, butylddchloroborane, isobutyldichloroborane, tertbutyldichloroborane, secbutyldichloroborane, phenyldichloroborane, methylboric acid, ethylboric acid, trichloroborazine, borane-tetrahydrofuran, tetrafluoroboric acid,,boron trichloride, tre-sec-butylborane, boran-trimethylamine, borane-triethylamine, borane-N,N-diethylaniline, boran-pyridine, borane-tert-butylamine, borane-morpholine, borane-dimethylamine, borane-diethylamine, trisiamylborane, trisiamylborate, disiamyl-borane, disiamylborate, trimesitylborane, sodium metaborate, lithium metaborate, potassium metaborate, sodium metaborane, borane-tributylphosphine, lanthanum hexaboride, boran-triphenylphosphine, boran-tributylphosphine, cyclopentadienylboran, methylcyclopentadienylboran, boran-N,N-diisopropylborohydride, N,N-bis(mono-isoipinocampheylborane)-N,N,N.N.-tetramethylet

hylenediamine, boron nit,ride, 4-(borane-dimethylamine) benzene, 4-(borane-dimethylamine) pyridyl, 3-(methylthio)proplyborane, tris(dimethylamino)borane, butyldiisopropoxyborane, triphenyl borane sodium, sodiumtetraphenylborane, sodiumtetraphenylborane, sodium tetrakis(l-imidazolyl)borane, sodium tetrakis(1-imidazolyl)borate, diisopropoxyphenylborate, diisopropoxymethylborate, diisopropoxyethylborate, boron-ammonia, borontrifluoride, diethyl(3-pyridyl)borane, dimethyl(3-pyridyl)borane, lithium thexylborohydride, dichloromethyldiisopropylborate, diethyl-methoxyborane, dipropylmethoxyborane, diisopropylmethoxyborane, diethylethoxyborane, dipropylethoxyborane, diisopropylethoxyborane, boran-piperidine, diphenylborinic anhydride, tris(tri-methylsilyl)borate, tris(trimethylsilyl)borane, trimethylacetic acid with diethylboinic acid, (2-methylpropyl)borinic acid, boroglycine, boron alchols, boron etherates, boron acetates (e.g. propylborodiacetate, phenyl-borodiacetate, boron tris(trifluoro)acetate), sodium tris(l-pyrazolyl)borohydride, sodium perborate, tolylboronic acid, aluminum diboride, chlorodicyclohexylborane, methyldicyclohexylborane,

ethyldicyclohexylborane, propyl-dicyclohexylborane, isopropyldicyclohexylborane, dimethyl-cyclohexylborane, diethylcyclohexylborane, dipropylcyclohexylborane, diisopropylcyclohexylborane, lithium tetramethylboron, lithium tetraethylboron, lithium tetrapropyllboron, lithium tetraisopropylboron, tetrabutylboron, lithium tetraisobutylboron, lithium tetra-sec-butylboron, tetra-tert-butylboron, lithium tetraphenylboron, potassium hydroxide with trimethylboron, potassium hydroxide with triethylboron, potassium hydroxide with tripropyllboron, potassium hydroxide with tri-isopropylboron, tributylboron, potassium hydroxide with tri-isobutylbbron, potassium hydroxide with tri-sec-butylboron, tri-tert-butylboron, potassium hydroxide with triphenylboroh, vinylphenylboronic acid, 4-vinylphenylboronic acid, boron phosphide, boron carbide, borinoaminoborine, boroethane, pentaborane, hexaborane, decaborane, triselenideborane, hexasilicide borane, trisilicide borane, trichloroborine dimethyletherate, trichloroborine trimethlyammine, trimethylborine trimethlyammine, trimethylborine triethlyammine, triethylborine trimethlyammine, tricyclohexylborine, tri-n-hexyltriborine trioxane, triisoamylborate,

triisoamylborine, tri-p-anisylborine, trimethoxyboroxine, tri-methylamminoborine, triethylamminoborine, tripropylamminoborine, triisopropylamminoborine, triisobutylamminoborine, tributylamminoborine, tri-sec-butylamminoborine, tri-tert-butylamminoborine, triphenyl-amminoborine, tribenzylamminoborine, trimethylamminoboric acid, triethylamminoboric acid, tripropylamminoboric acid, triisopropylamminoboric acid, triisobutylamminoboric acid, tributylamminoboric acid, tri-sec-butylamminoboric acid, tri-tert-butylamminoboric acid, triphenylamminoboric acid, tribenzylamminoboric acid, trimethyldiborane, triethyldiborane, tripropyldiborane, trimethylt-riborinetriamine (B), triethyltriborinetriamine (B), trimethyltriborinetriamine (N), triethyltriborinetriamine (N), trimethyltriborinetriamine (N-B-B^1), triethyltriborinetriamine (N-B-B), tri-B-naphthylborate, tri-a-naphthaborate, tripehnylborineammine, tri-p-tolyborine, tri-p-xylxborine, including analogues, homologues, isomers and derivatives thereof. Corresponding compounds of aluminum, gallium, indium, and thallium are contemplated. See <u>Organo Boron Chemistry,</u> Volumes I & II (and subsequent volumes, editions, or

supplements), Howard Steinberg, InterScience Publishers (1966), Boron-Nitrogen Compounds, Niedenzu, Dawson, New york, Academic Press (1965), The Organic Compounds of Boron, Aluminum, Gallium, Indium, and Thallium, Nesmeianov, Nikolaevich, Amterdam, North-Holland Pub. Co. (1967), Peroxides, Superperoxides, and azomides of Alkali and Alkali Earth Metals, Perekisi, N.Y., Plenum Press (19966), incorporated herein by reference.

Non-limiting examples of sodium derivative compounds of this invention include: sodium bis(dimethylsilyl)amide, sodium bis(trimethylsilyl)amide, pxamic acid, P-aminosalicylic acid sodium salt, sodium salt 5-nitroorotic acid, sodium D-gluconate, sodium hexacyanoferrate(JII) (Li3Fe(CN)6), sodium diphenylphosphide, sodium acetate, sodium acetate acid, sodium salt acetic acid, sodium acetamide, sodium anilide, sodium azide, ammonium diisodium amminepehtacyanoferrate, sodium benzamide, sodium, antimonide, sodium brthoarsenate, sodium orthoarsenite, sodium meta-atsenite, sodium diborane, sodium pentaborate, sodium dihydroxy diborane, sodium borohydride, sodium cadium iodide, sodium chloride, sodium calcium chloride, sodium carbide, sodium carbonate, sodium hydrogen carbonate, sodium alkyl carbonates, sodium aryl carbonates, sodium methyl carbonate, sodium ethyl carbonate, sodium carbonyl, sodium

cobalt (II) cyanide, sodium cobalt (III) cyanide, sodium cobaltinitrite, sodium cynomanganate (II), sodium cynomanganate (III), sodium citrate, sodium ferrosilicoh, sodium ferricyanide, sodium ferrocyanide, sodium nitroferricyanide) sodium aminepentacyanide, sodium formates, sodium hydride, sodium,hydroxide, sodium manganate, sodium permanganate, sodium methionate, sodium napthenate, sodium nitride, sodium nitrate, sodium nitrite, sodium nitrobenzene (e.g. sodium-p-nitrobenzene), sodium nitrophenoxide, sodium etherate, sodium chromate, sodium oleate, sodium oxalate, sodium oxalatoferrate (II), sodium oxalatoferrate (III), sodium monoxide, sodium oxide, sodium peroxide, sodium, sodium mono-orthophdsphate, sodium hypophosphite, sodium orthophosphite, sodium hydroxoplumbate, sodium rhodium cyanide, sodium selenide, sodium selenite, sodium selenocynate, sodium selenocyanoplatinate, sodium disilicate, sodium metasilicate, lithium sodium carbonate, lithium sodium ferricyanide, sodium hydroxostannate, sodium disufide, sodium hydrosulfide, sodium pentasulfide, sodium tetrasulfide, sodium trisulfide, sodium telluride, sodium thioarsenate, sodium thioarsenite, sodium trithiocarbonate, sodium thiocyanate, sodium amide, sodium salt (E,E)-2,4-hex-adienoic acid, disodium fluorophosphate,

disodium fluorophosphite, trisodium phosphate, trisodium phosphite, sodium perchlorate, propanoic acid sodium salt, sodium formate, sodium cyanate, sodium hexacyanocobaltate (III), sodium hypophosphite, sodium hexaflurorsilicate, sodium nitroprusside, sodium phenoxide, sodium phosphate (dibasic, monobasic, tribasic), sodium salicylate, sodium selenide, sodium tetracyanonickelate (II), sodium tetrafluoroborate, sodium xanthogenate, sodium -p-aminobenzoate, sodium copper ferrocynanide, sodium cupric ferrocyanide, sodium hexafluorophosphate, sodium hexanitricobaltate III, sodium naphthenate, sodium -B-naphthoxide, sodium polysulfide, lithium -sodium phosphate, sodium stearate, sodium sulfide, sodium sulfite, sodium sulfate, sodium thiocyanate, sodium xanthate, sodium fluorosilicate, N-sodiumethylenediamine, oxalic acid disodium salt, sodium beta-hydropyruvic acid, sodium 1,1-dimethylurea, sodium 1, l-.diethylurea, sodium 1,1-diepropylurea, sodium xanthate, sodium ethylxanthate, sodium methylxanthate, sodium salt thiophenol, sodium triphenylmethylsodium, methylsodium, ethylsodium, sodiumethynyl(acetylide), propylsodium, isopropylsodium, butylsodium, isobutylsodium, secbutylsodium, tertbutylsodium, pentasodium, hexylsodium, heptasodium, amylsodium,

isoamylsodium, benzylsodium, dimethylbenzylsodium, tolylsodium, dodecylsodium, eyelopentadienylsodium, methyleyelopentadienylsodium, cyclohexylsodium, sodiumheptyl, sodiumdodecyl, sodium tetradecyl, sodium hexadecyl, sodium octadecyl, phenylsodium, sodium o-tolyl, sodium m-tolyl, sodium p-tolyl, sodium-p-chlorophenyl, sodium p-bromophenyl, sodium o- anisyl, sodium m-anisyl, sodium p-anisyl, sodium diethoxyphenyl, sodium dimethoxyphenol, sodium m-cumyl, sodium p-ethoxyphenyl, sodium m-dimethylaminophenyl, sodium 9-flourene, sodium a-napthyl, sodium b-napthyl, sodium p-phenylphenyl, sodium 9-phenylanthryl, sodium 9-anthryl, sodium 9-methylphenanthryl, sodium pyridyl, sodium 2-pyridyl, sodium 3-pyridyl, sodium 6-bromo-2-pyridyl, sodium 5-bromo-2-pyridyl, sodium dibenzofuryl, sodium 3-quinoyl, sodium 2-lepidyl, sodium triphenylmethyl, sodium 2,4,6-trimethylphenyl, sodium 2,4,6-triisopropylphenyl, sodium 2,3,5,6-tetraisopropylphenyl, sodium tetrabutylphenyl, thiophenedisodium, toluenedisodium, diphenylethylenedi-sodium, sodiumamylethynyl, sodiumphenylethynyl, sodium-met hoxybromophenyl , sodium phenylisopropyl, sodium tetraphenylboron, sodium tetramethylboron, sodium a-thienyl, sodium m-trifluoromethylphenyl, phenylethynylsodlum,

3-furylsodium, phenylisopropylsodium, dibenzofuranylsodium, sodium dimethylbenzyl, sodium selenocyanate, sodium trimethylsilanolate, diphenylphosphide, sodium benzoate, sodium tert-butyl carbonate, sodium azide, di-sodium-cyanamide, sodium cyanide, sodium dicyanamide, cyclohexanebutyric acid sodium salt, cyclohexane acid sodium salt, cyclopentadientylsodium, sodium tri-tert-butoxyaluminum hydride, sodiumaluminum-tri-tert-butoxide, sodium triethylborohydride, sodium trimethylborohydride, sodium tripropylborohydride, sodium triisopropylborohydride, sodium tributylborohydride, sodium triisobutylborohydride, sodium tri-sec-butylborohydride, sodium tri-tert-butylborohydride, sodium trisiamylborohydride, sodium chlorate, sodium tert-butoxide, sodium sec-butoxide, iso-butoxide, sodium antimonate, sodium diphenylphosphide, sodium bis(trismethylsilyl) amide, trisodium phosphite, sodium selenocyanate, sodium tri-sec-butylborohydride, , sodium triethylsilanolate, sodium thiocyanate, sodium acetylide, sodium chlorate, sodium salicylate, sodium di-sodium tetracarbonylferrate, sodium tetraphenylborate, sodium triethylborohydride, sodium triacetoxyborohydride, sodium triphenylborane, sodium hydroxide, sodium, diphenylphosphide,

sodium methoxide, sodium ethoxide, sodium tri-sec-butylborohydride, tri-tert-butylborohydride, sodium triethylborohydride, sodium triphenylborohydride, sodium trisiamylborohydride, sodium metavanadate, sodium cyclohexanebutyrate, sodium hexachloroplatinate, sodium thiocyanate, sodium selenocyanate, sodium cyanate, sodium floride, sodium hexafluoroantimonate, sodium hexafluoroaluminate, sodium hexafluoroarsenate, sodium hexafluorosilicate, sodium hexacyanocobalt(II)ferrate(II), disodiumhexacyanocobalt(II)ferrate(II), sodium hexafluorotitanate, sodium hexafluorozirconate, sodium hexa-hydroxyantimonate sodium hexachlororuthenate, sodium hexachloropalladate, sodium formate, sodium tetracyanonickelate, sodium tetrafluoroaluminate, sodium tetrafluoroborate, sodium thioacetate, L-glutamic acid monosodium salt, fumaric acid sodium salt, oxamic acid sodium salt, sodium salt diphenyl-phospane, P-aminobenzoic sodium salt, aminobenzole acid sodium salt, alpha-napthaleneacetic acid sodium salt, disodium salt 2,6-naphth-alenedicarboxlic acid, sodium cyclcohexanetherate, sodium phthalimide, P-aminosalicylic acid sodium salt, sodium salt 3,5-dimethylcyclohexyl sulfate, indolebutyric acid sodium

salt,indole-3-butyric acid sodium salt, diphenylphosphide, sodium dimethylsilanolate, sodium triethylborohydride, sodium propoxide, sodium isopropoxide, sodium butoxide, sodium sec-butoxide, sodium pentoxide, sodium tert-pentoxide, sodium hydrogenphthalate, sodium oxalate, sodium hydrogensulfate, monosodium acetylenedicarboxylic acid, sodium pyrophosphate, sodium dihydrogenphosphate, sodium hexoate (sodium salt hexoic acid), sodium diphenylphosphide, sodium trimethylsilonalate, sodium phthalic acid, P-aminobenzoic acid sodium salt, monosodium L-aspartic acid, tetraphenyldisodium (C6H5)2CLi2C(C6H5)2, sodiumethylphenyl (L1CH2G6H5), sodium bromate, sodium hydrogenphospate, monsodium salt D-shaccharic acid, Dl-asparatic sodium salt, (R)-alpha-hyroxymethylaspartic acid sodium salt, sodium fluoride, sodium iodate, sodium salt ethyl malonate, sodium thioacetate, sodium phenol, sodium salt aminobenzoic acid, sodium aminophenol salt, sodium cyclohexenol, sodium methylcyclohexenol, sodium cyclopropanol, sodium tnethylcyclopropanol, sodium cyclobutanol, sodium methylcyclobutanol, sodium methylcyclopentanol, sodium cyclopentanol, sodium cyclohexenol, sodium methyl-cyclohexenol, sodium dimethyleyelohexenols (e.g. sodium.3,5-dimethylcyclohexanol, sodium

2,3-dimethylcyclohexanol, sodium 2,6-dimethylcyclohexanol, sodium 2,5-dimethylcyclohexanol, 3,5-dimethyleyelohexanol), sodium o-ethylxahthic acid, monosodium salt 2-ketoglutaric acid, disodium salt, ketomalonic acid, sodium salt lactic acid, disodium thiosulfate, sodium antimony tartrate, sodium dichloroaceta/te, sodium dimethylacetate, sodium diethylacetate, sodium dipropylacetate, sodium metaborate, sodium tetraborate, sodium tetrachlorocuprate, sodium acetoacetate, sodium diisopropylamide, sodium diethylamide, sodium dimethylamide, sodium bis(dimethylsilyl)amide, disodium phthalocyanine, disodiumtetrabromocuprate, disodium tetrabromonickelate, disodiumtetrachloromanganate, disodiumbutadiyne, sodium cyclopentadienide, sodium dicyclohexylamide, sodium diethylamide, sodium dimethyl-amide, sodium dipropylamide, sodium diisopropylamide, sodium thexylborohydride sodium tri-tert-butoxyaluminohydride, sodium trimethylsilyl)acetylide, sodium triethylsilyl)acetylide, sodium tris[(3-ethyl-3-pentyl)oxy]aluminohydride, (phenylethynyl)sodium, 2-thienylsodium, sodium diethyldihydroaluminate, spdium dimethyldihydroaluminate, sodium aluminum hydride, sodium bifluoride, sodium biphenyl,

sodium biselenite, sodium bis(2-methoxyethoxy)aluminum hydride, sodium bismuthate, sodium borate, sodium chlorite, sodium cobaltnitrite, sodium cyanoborohydride, sodium cyclopentadienide, sodium dicyanamide, sodium hexametaphosphate, sodium hexanitrocolbaltate, sodium hydrogenphosphite, sodium hydrogenselenite, sodium hydrogensulfite, sodium hydrosulfite, sodium hypochloride, sodium metaarsenite, sodium metabisulfide, sodium metaperiodate, sodium methacrylate, sodium nitroferricyanide, oxybate, sodium pentamethylcyclopentadienide, sodium phenolate, polyphosphate, sodium polyphosphite, sodium propionate, sodium pyrophosphate, sodium selenate, sodium selenite, sodium tetrachloroaluminate, sodium thiomethoxide, sodium thiosulfate, sodium thiosulfide, sodium thiosulfite, sodium triactoxyborohydride, sodium trimethylsilonate, sodium triethylsilonate, sodium tris(1-pyrazoly)borohydride, including analogues, homologues, isomers and derivatives thereof.

The non limiting examples of aluminum derivative compounds of this invention include: diisobutylaluminum hydride, dimethylaluminum hydride, dimethylaluminum hydride, dipropylaluminumhydride, diisopropylaluminumhydride,

dibutylaluminumhydride, di-tert-butylaluminum hydride, di-sec-butylaluminum hydride, diisobutylaluminum chloride, ethylaluminum sesquichloride, lithium aluminum hydride, lithium tri-tert-butoxyaluminum hydride, lithium-aluminum alloy, aluminum triethoxide, aluminum trimethoxide, aluminum tripropoxide, aluminum triisopropoxide, aluminum tri-tert-butoxide, aluminum tri-sec-butoxide (aluminum sec-butoxide), aluminum tri-isobutoxide, aluminum tributoxide, aluminum pentoxide, diethylaluminum ethoxide, aluminum phosphate, diethylaluminum chloride, diethylaluminum cyanide, diethylaluminum ethoxide, diethylaluminum methoxide, diisobutylaluminum hydride, diisobutylaluminum chloride, diisobutyalumnum fluoride, tetraisobutyldialuminoxane, triethylaluminum, trimethylaluminum, tributylaluminum, triisobutylaluminum, tri-sec-butylaluminum, tri-tert-butylaluminum, tripentaluminum, triphenylaluminum, triamylaluminum, triisoamylaluminum, tripropylaluminum, tri-isopropylaluminum, triisobutylaluminum, triisobutyldialuminoxane, trioctylaluminum, sodium aluminum hydride, bis(2-methoxyethoxy)aluminum hydride, aluminum borohydride, aluminum hydride, dimethlylberyllium, potassium tri-tert-butoxyaluminum hydride, sodium

tri-tert-butoxyaluminum hydride, lithium tri-tert-butoxyaluminum hydride, aluminum sec butoxide, aluminum tert-butoxide, aluminum acetylacetone, aluminum ethoxide, aluminum methoxide, aluminum propoxide, aluminum isopropoxide, aluminum butoxide, aluminum isobutoxide, aluminum pentoxide, aluminum metaphosphate, aluminum hydroxide, aluminum metaphosphite, aluminum hydroxystearate, aluminum monos-tearate, aluminum nitrate, aluminum fluoride, aluminum fluoride trihydrate, sodium diethyldihydroaluminate, sodium hexafluoroaluminate, aluminum hexafluorosilicate, lithium aluminum hydride, lithium aluminum hydride bis(tetrahydrofuran), lithium tris((3-thyl-3-pentyl)-oxy)aluminohydride, lithium tri-tert-aluminohydride, aluminum-nickel catalyst, aluminum silicate, aluminum silicate hydroxide, aluminum chloride hydrate, diethylaluminum chloride, sodium bis (2-methoxyethoxy)aluminum dihydride, aluminum carbide, aluminum phosphate, aluminum acetate (aluminum diacetate hydroxide), dihydroaluminum acetate, aluminum formoacetate, lithium aluminate, aluminum salt lactic acid, tetramethyllithiumaluminum salt (LiAl(CH3)4), tetaethyllithiumaluminum salt, tetrapropyllithiumaluminum

salt, tetraisopropyllithiumaluminum salt, tetra-butyllithiumaluminum salt, tetraisobutyllithiumaluminum salt, tetra-sec-butyllithiumaluminum salt, tetra-tert-butyl-lithiumaluminum salt, tetraphenyllithium aluminum salt, aluminum tririconoleate, aluminum metaphosphate, sodium aluminum hydride, aluminum dodecaboride, aluminum diboride, aluminum arsenide, aluminum lactate, aluminum titanium chloride, tri (N-nitroso-N-phenylhydroxylaminoato)aluminum, aluminum acetylacetonate, methylaluminum dichloride, ethylaluminum dichloride, propylaluminum dichloride,, isopropylaluminum dichloride, butylaluminum dichloride, sec-butylaluminum dichloride, tert-butylaluminum dichloride, isobutylaluminum dichloride, phenylaluminum dichloride, ethylaluminum sesquichloride, methylaluminum sesquichloride, methylaluminoxane, propylaluminum sesquichloride, ethylaluminoxane, sodium bis(2-methoxyethoxy)aluminum, aluminum magnesium silicate, aluminum hydroxychloride, aluminum phosphide, aluminum potassium sulfide, aluminum octoate (aluminum ethylhexonate), aluminum diformate, aluminum triformate, aluminum chromate, aluminum napthenate,

aluminum oleate, aluminum palmite, aluminum pictrate, aluminum sodium silicate, aluminum sodium chloride, aluminum isopropylate, aluminum magnesium ethoxide, trimethylaluminum etherate, triethylalutninum etherate, including analogues, homologues, isomers and derivatives thereof. Corresponding compounds of gallium, indium, thallium are contemplated in the practice of this invention.

The non-limiting examples of silicon derivative compounds of this invention include: dimethoxymethylsilane, dimethoxyethylsilane, diethoxymethylsilane, dipropoxymethyl-silane, diisopropoxymethylsilane, dibutoxymethylsilane, diisobutoxymethylsilane, di-sec-butoxymethylsilane, di-sec-butoxymethylsilane, diethoxyethylsilane, dipropoxyethyls-ilane, diisopropoxyethylsilane, dibutoxyethylsilane, diisobutoxyethylsilane, di-sec-butoxyethylsilane, di-sec-butoxyethylsilane, diethoxydimethylsilane, dimethoxydi-methylsilane, dipropoxydimethylsilane, diisoprop-oxydimethylsilane, dibutoxydimethylsilane, diisobu-toxydimethylsilane, di-sec-butoxydimethylsilane, di-sec-butoxydimethylsilane, diethoxymethylethylsilane, ethoxytrimethylsilane, ethoxytriethylsilane,

ethoxytri-propylsilane, ethoxytriispropylsilane, methoxytrimethylsilane, propoxytrimethylsilane, isoprop-oxytrimethylsilane, butoxytrimethylsilane, isobutoxytrimeth-ylsilane, sec-butoxytrimethylsilane, sec-butoxytrimethylsilane, phenoxytrimethylsilane, ethoxydiethylsilane, isobutyldiethoxysilane, sec-butyldiethoxysilane, butyl-diethoxysilane, tertbutyldiethoxysilane, pentyl-diethoxysilane, isobutyldimethoxysilane, secbutyldimethoxysilane, butyldimethoxysilane, tertbutyltri-methoxysilane, methyltrimethoxysilane, methyltriethoxy-silane, pentyldimethoxysilane, diethylsilandiol, tripropylsilandiol, triisopropylsilandiol, tertbutyldimethylsilane, diethylsilanediol (C2H5Si(OH)2), methyl-tripropoxysilane, methyl-tris(dimethylsiloxy)silane, 1,1-diphenylsilacyclohexane, pentamethylsilanime, 1,1,1-trimethyl-N-phenyl-N-silanamine, hexamethyldisilazane, [1,1-biphenyl]-4-yltrichlorosilane, (bromomethyl)chloro-dimethylsilane, bromotnethyltrimethylsilane, (4-bromophenoxy)trimethylsilane, butylchlorodimethylsilane, trichlorobutylsilane, trimethylbutylsilane, chloro(chloromethyl)dimethylsilane,

chloro(dichloromethyl)dimethylsilane,

chlorodimethylphenyl-silane, chlorodimethyl-2-propenylsilane,

chloroethenyldimethylsilane, chloromethylsilane,

(chloromethyl)dimethylphenylsilane,

chlorome-thyldiphenylsilane, chloromethylphenylsilane,

(chloromethyl) trimethylsilane,

(4-chloropehoxy)trimethylsilane, phenylchlorosilane,

(3-chlorophenyl)trimethylsilane,

(3-chloropropyl)trimethylsilane, chlorotriethoxysilane,

chlorotriethylsilane, trimethylchlorosilane,

dichloro(chloromethyl)methylsilane,

dichloro(dichloromethyl)methylsilane, dichlorodiethoxysilane,

dichlorodiethylsilane, dichlorodimethylsilane,

dichlorodiphenylsilane, dichloroethenylmethylsilane,

methylethyldichlorosilane, dichloromethylsilane,

dichloromethyl(1-methylethyl)silane,

dichloromethyl(4-methylphenyl)silane,

dichloromethylphenylsilane,

dichloromethyl-2-propenylsilane,dichlorophenylsilane,

diethenyl-diphenylsilane, diethoxydimethylsilane,

diphenyldiethoxysilane, diethoxymethylphenylsilane,

diethyloxymethyl-2-propenylsilane, diethylsilane,

diethyldifluorosilane, difluorodiphenylsilane, dimethyoxydimethylsilane, dimethoxydiphenylsilane, dimethylsilane, dimethyldiphenoxysilane, dimethyldiphenylsilane, dimethyl-2-propenylsilane, dimethylphenylsilane, dimethyl-diacetatesilane, diphenylsilane, 1,2,-ethenediylbis[trimethyl-(E)]silane (C8H20Si2), ethenyldiethoxymethylsilane, ethenylethoxydimethylsilane, ethenyltriethoxysilane, ethenyltrimethylsilane, ethenyltris(1-methylethoxy)-silane, ethenyltris(2-propenyloxy)silane, ethoxytriethylsilane, ethoxytrifluorosilane, ethoxytrimethylsilane, ethoxytri-phenylsilane, ethyltrifluorosilane, ethyltrimethoxysilane, 1,2,-ethynediylbis[trimethyl]silane, ethynylsilane, methoxysilane, methylsilane, methyldiphenylsilane, methylenebissilane, methylenebis[trichloro]silane, (2-methylphenoxy)triphenylsilane, methylphenylsilane, methyltriphenoxysilane, methyltriphenylsilane, methyltri-p-toly-silane, phenylsilane, [1,3-phenylenebis(oxy)]bis-[trimethyl]silane, phenyltripropylsilane, tetraethenylsilane, tetraethylsilane, tetraethoxysilane, tetramethylsilane, tetramethoxysilane,

tetrapropylsilane, tetrapropoxysilane, tetraisopropylsilane, tetraisopropoxysilane, tetrabutylsilane, tetrabutoxysilane, tetra-sec-butylsilane, tetra-sec-butoxysilane, tetra-tert-butylsilane, tetra-tert-butoxysilane, tert-iso-butylsilane, tetra-iso-butoxysilane, tetraphenylsilane, tetra-phenoxysilane, triethylsilane, triethoxysilane, trimethylsilane, trimethoxysilane, tripropylsilane, tripropoxysilane, triisopropylsilane, triisopropoxysilane, tributylsilane, tributoxysilane, tri-sec-butylsilane,, tri-sec-butoxysilane, tri-tert-butylsilane, tri-tert-butoxysilane, tert-iso-butylsilane, tri-iso-butoxysilane, triphenylsilane, triphenoxysilane, triethylmethylsilane, triethoxymethylsilane, trimethoxymethylsilane, tripropylmethylsilane, tripropoxymethylsilane, triisopropyl-methylsilane, triisoproxymethylsilane, tributylmethylsilane, tributoxymethylsilane, tri-sec-butylmethylsilane, tri-sec-butoxymethylsilane, tri-tert-butylmethylsilane, tri-tert-butoxymethylsilane, tert-iso-butylmethylsilane, tri-iso-butoxymethylsilane, triphenylmethylsilane, triphenoxymethylsilane, diethylsilane, diethoxysilane, dimethylsilane,

dimethoxysilane,,dipropylsilane, dipropoxysilane, diisopropylsilane, diisopropoxysilane, dibutylsilane, dibutoxysilane, di-sec-butylsilane, di-sec-butoxysilane, di-tert-butylsilane, di-tert-butoxysilane, tert-iso-butylsilane, di-iso-butoxysilane, diphenylsilane, diphenoxysilane, ethyl.silane, ethoxysilane, methyl si lane, methoxysilane, propylsilane, prbpoxysilane, isopropylsilane, isoproxysilane, butylsilane, butoxysilane, sec-butylsilane, sec-butoxysilane, tert-butylsilane, tert-butoxysilane, iso-butylsilane, iso-butoxysilane, phenylsilane, phenoxysilane, tribromomethylsilane, tributylsilane, tributylphenylsilane, trichloro(chloromethyl)silane, trichloro(4-chlorophenyl)silane, trichloro(3-chloropropyl)silane, trichloro(dichloromethyl)silane, trichlorododecylsilane, trichloroethenylsilane, trichloroethoxysilane, trichloroethylsilane, trichlorohexylsilane, trichloromethy-Isilane, trichloro(1-methylethyl)silane, trichloro(2-methyl-phenyl)silane, trichloro(3-methylphenyl)silane, trichloro(2-methylpropyl)silane, trichlorootadectylsilane, tri-chlorooctylsilane, trichloropentylsilane,

trichlorophenylsilane, trichloro(2-phenylethyl)silane, trichloro-2-propenylsilane, trichloropropylsilane, triethoxysilane, triethoxyethylsilane, triethoxyethylsilane, triethoxyphenylsilane, triethoxypentylsilane, triethoxy-2-propenylsilane, triethylsilane, triethylfluorosilane, triethylphenylsilane, trifluorophenylsilane, trimethoxymethylsilane, trimethoxyethylsilane, trimethoxypropylsilane, trimethoxyisopropylsilane, trimethoxybutylsilane, trimethoxyisobutylsilane,trimethoxy-sec-butylsilane, trimethoxy-tert-butylsilane, trimethoxyphenylsilane, trimethylsilane, trimethyl(4-methylphenyl)silane, trimethyl(2-methylpropyl)silane, trimethylphenoxysilane, trimethylphenylsilane, trimethyl-(phenylmethyl)silane, trimethyl(cyclohexylmethyl)silane, trimethyl-2-propenylsilane, trimethylpropylsilane, trimethyl[4- [(trimethylsilyl)oxy]phenyl]silane, ethenyl-tri-acetatesilanetriol, methyl-triacetatesilantriol, tripropylsilane, ethyldimethylsilanol, methyldiphenylsilanol, triethylsilanol, triphenylsilanol, tetrabutyl ester silicic acid (C16H36O4Si), tetraethyl ester silicic acid, tetrakis(2-ethylbutyl) ester silicic acid, methylsilicate

(C4H12SiO4), tetraphenyl ester silicic acid, tetrapropyl ester silicic acid, triethyl phenyl ester silicic acid, 1,2-dichloro-l,1,2,2-tetramethyldisilane, 1,2,-difluorotetramethyldisilane, hexamethyldisilane, 1,3-diethenyl-1,1,3,3-tetramethyldisiloxane, 1,3-diethenyl-1,1,3,3-tetramethyldisilazane, bis-(methoxydimethylsilyl)oxide, 1,1,1,3,3,3-hexaethyldisiloxarie, 1,1,1,3,3,3-hexaethyldisilazane, hexamethyldisiloxane, hexamethyldisilazane, 1,1,3,3-tetramethyldisiloxane, 1,1,3,3-tetramethyldisilazane, 1, 1,3,3-tetramethyl-l, 3-diphenyldisiloxane, 1,1,3,3-tetramethyl-1,3-diphenyldisilazane, 1,1,l-trimethyl-3,3,3-triphenyldisiloxane, 1,1,l-trimethyl-3,3,3-triphenyldisilazxane, docosamethyldecasiloxane, docosamethyldecasilazane, ethenylhep-tamethylcyctetrasiloxane, ethenylheptamethylcyctetrasilazane, heptamethyl-cyclotetrasiloxane, heptamethylcyclotetrasilazane, octaphenylcyclotetrasiloxane, butylmethyl (cyclic tetramer)siloxane, 2,4,6,8-tetraethenyl-2,4,6,8-tetramethylcyclotetrasiloxane

(C12H24O4Si4), 2,4,6,8-tetraethyl-2,4,6,8-cyclotetrasiloxane, 2,4,6,8-tetraethyl-2,4,6,8-cyclotetrasilazane, 2,4,6,8-tetraethyl-2,4,6,8-cyclotetrasiloxane, 2,4,6,8-tetramethylcyclotetrasiloxane, 2,4,6,8-tetramethylcyclotetrasilazane, 2,4,6,8-tetramethyl-2,4,6,8-tetraphenylcyclotetrasiloxane, 2,2,4,4,6,6-hexamethylcyclotrisilazane, hexamethylcyclotrisiloxane, 2,4,6-triethyl-2,4,6-trimethylcyclotrisiloxane, 2,4,6-triethyl-2,4,6-trimethylcyclotrisiloxane, 2,4,6-triethyl-2,4,6-triphenylcyclotrisiloxane, 2,4,6-trimethyl-2,4,6-tripehnylcyclotrisiloxane, decamethylcyclopentasiloxane, decamethylcyclopentasilazane, 2,4,6,8,10-pentamethylcyclopentasiloxane, 2,4,6,8,10-pentamethylcyclopentasilazane, octademethyl-cyclononasiloxane, octademethylcyclononasilazane, hexadecamethylcyclooctasiloxane, hexadecamethyl-cyclooctasilazane, dodecatnethylcyclohexasiloxane, dodecamethylcyclohexasilazane, hexamethylcyclohexasiloxane, tetradecamethylcycloheptasiloxane,

tetra-decamethylcycloheptasilazane, decamethyltetrasiloxane, 1,1,1,3,5,7,7,7-octamethyltetrasiloxane, aminotrisilane, benzyltriethoxysilane, butyltrifluorosilane, carboxyethyl-dimethyls i lane, chloromethyls i li cane, chlorotriisocyanatesilane, dichloromethylsilicane, diethoxydibutoxysilane, diethylanilinefluorosilicate, diethyldichlorosilane, [2-(cyclohexenyl)ethyl] tri-ethoxysilane,

[2-(cyclohexenyl)ethyl]methyldiethoxysilane,

[2-(cyclohexenyl)ethyl]dimethylethoxysilane,

[2-(cyclohexenyl)ethyl] trimethylsilane,

[2-(cyclohexenyl)ethyl] triethylsilane,

cyclohexyldimethoxymethylsilane, cyclohexylmethoxydimethyl-silane, cyclohexyltrimethylsilane, cyclohexyltriethylsilane, dicyclohexyldimethylsilane, cyclohexyldimethylsilane, cyclohex-1-enyl-trimethylsilane, benzyltrimethylsilane,

(1-cyclohexen-1-ylethynyl)trimethylsilane, 1-cyclohexenyltrimethylsilane, cyclohexenyloxytrimethylsilane, cyclohexyltrichlorosilane,

1-cyclopropyl-1-(trimethy-Isilyloxy)ethylene,

phenyldimethylsilanol, phenylsilandiol, cyclohexylsilandiol,

cyclohexylethylsilandiol, tert-butylsilandiol, cyclohexyldimethylsilanol, cyclohexyl-diethylsilanol, benzyltrimethylsilane, N-benzyltrimethyl-silylamine, phenyl dimethylsilanol, phenyl diethylsilanol, cyclohexylethylenetrimethylsilane, N-cyclohexylethylenetrimethylsilylamine, cycloethylenetrimethylsilane, diphenyldiethoxysilane, diphenyldimethoxysilane, diphenyl-methyl-ethoxysilane, diphenylmethylsilane, diphenylmethylsilandiol, diphenylsilandiol, methyl-phenyl-diethoxysilane, methyl-phenyl-dimethoxysilane, methyl-phenyl-dichlorosilane, octadecyltrimethoxysilane, octyltriethoxysilane, octyltrimethoxysilane, 1,3-bis (3-aminopropyl)-1,1,3,3-tetramethyldisiloxane, 1,3-bis(3-aminopropyl)-1,1,3,3-tetramethyldisilazane, tertbutyldimethylsilandiol, hydroxymethylenetrimethylsilane (CH3)3CH2OH), hydro-xyethylenetrimethylsilane, hydroxymethyltriethylsilane, hydroxyethyltriethylsilane,diethylsilanediol, dimethylsilanediol, dipropylsilanediol, diisopropylsilanediol, dibutylsilanediol, di-tert-butylsilanediol, di-iso-butylsilanediol,

di-sec-butyl-silanediol, diphenylsilanediol, dicyclohexylsilanediol, cyclohexylmethylsilanediol, cyclohexylethylsilanediol, dimethoxydichlorosilane, dimethylanilineflourosilicate, dimethyldi(B-chloroethoxy)silane, dimethylflourochlorosilane, dimethylsilicane, di-a-napthylamineflourosilicate, di-b-napthylamineflourosilicate, di-m-nitranilineflourosilicate, dinitrosodiphenylamine, diphenylarsinophenylenetriethylsilane, diphenyl-dichlorophenoxysilane, di-o-toluidinefluorosilicate, di-ra-toluidinefluorosilicate, di-p-toluidinefluorosilicate, docosamethyldecasiloxane, dodecamethylcyclohexasilgxane, dodecamethylpentasiloxane, eicosamethylnonasiloxane, silanesilanesilanedocosamethyldecasilazane, dode-camethylcyclohexasilazane, dodecamethylpentasilazane, eicosamethylnonasilazane, ethyldiethoxyacetoxysilape, ethyldiethoxychlorosilane, ethylisocyanatesilane, ethyltriethoxysilane, ethyltriphenylsilicane, hexadacamethylcyclooctasiloxane, hexadacamethyl-cyclooctasilazane, hexamethylsilicane (hexamethyldisilane) , hexamethylmethylenedislane, hydroxymethyltrimethylsilane, methyl si licane,

methyltyriphenylsilicane, octadecamethylcotasiloxane, octamethylcyclotetrasiloxane, octamethyltrisiloxane, octadecamethylcotasilazane, octamethylcyclotetrasilazane, octamethyltrisilazane, tetraphenylenesilane, phenylenediamineflourosilicate, phenylisocyanatesilane; phenyltrichlorosilicane, silicobenzoic acid, tetra-m-aminoptienylsilane, tetrabenzyl-silicane, tetra-p-biphenylylsilane, tetradecamethylcyclohep-tasiloxane, tetradecamethylcycloheptasilazane, tetradecamethylhexasiloxane, tetradecamethylhexasilazane, tetraethylsilane, tetraethylthiosilane, tetrahexyloxysilahe, tetraisopropylmercaptane silicon, tetramethoxysilane, tetramethylmercaptanesilicon, tetramethylsilane, tetraphenoxysilane, tetraphenylsilane, tertapropoxysilane, tetratriethylsiloxysilane, thioisocyanatotriethylsilane, tolidinefluorosilicate(o), tri-p-Biphenylylphenylsilane, trichloromethyltriethoxysilane, triethylbromosilane, triethylchlorosilane, triethylfluorosilane, triethylphenylsilane, trimethylchloromethylsilane, trimethylethoxysilane, triphenylacetoxysilane, vinyltri-phenoxysilane, vinyltriethoxysilane, silicane cyanate, dibromosilane, dibromodichlorosilane, dichlorosilane,

dichlorodifluorosilane, hexaoxocyclosilane, hexacyclo-silazane, monooiodosilane, (tri-)nitrilosilane (silicylamine), trichlorosilane, trifluorosilane, silicane diimide (Si(NH)2), silicane tetramide, silicane isocyanate, silicon tetracetate, tetrabromosilarie, silicon hex(di-)bromide, silcon carbide, tertachlorosilane, hexachlorodi-silane, tetrafluorosilane, hexa-fluorodisilane, silicon hydride (SiH4), disilane (Si2H6), trisilanepropane, tetrasilane butane, silicon nitride, silicon thiocyanate, disilicic acid, silicon cyanate, allylchlorodimethylsilane, allylchloromethyldimethylsilane, allyl-dichlorodimethylsilane, allyl(diisoproprylamino)dimethyl-silane, allyloxy-tert-butyldimethylsilane, allyloxy-sec-butyldimethylsilane, allyloxy-iso-butyldimethylsilane, allylchlorodiethylsilane, allylchloromethyldiethylsilane, allyldichlorodiethylsilane, allyl(diisoproprylamino)diethyl-silane, allyloxy-tert-butyldiethylsilane, allyloxy-sec-butyldi ethyl-si lane, allyloxy-iso-butyldiethylsilane, allyl-oxybutyldimethylsilane, allyloxytrimethylsilane, allyloxy-triethylsilane, diallyloxydimethylsilane,

triallyloxymethylsilane, diallyloxydiethylsilane, triallyloxyethylsilane, diallyloxydimethoxylsilane, trial-lyloxymethoxylsilane, diallyloxydiethoxylsilane, tri-allyloxyethoxylsilane, allyltrichlorosilane, allyltriethoxy-silane, allyltriisopropylsilane, allyltripropylsilane, al-lyltriisopropyloxysilane, allyltripropyloxysilane, allyltri-methoxysilane, allyltrimethylsilane, allyltriethylsilane, allyltriphenylsilane, 3-aminopropyltriethoxysilane, 3-aminopropyltrimethoxysilane, 3-aminoethyltriethoxysilane, 3-aminoethyltrimethoxysilane, 3-aminomethyltriethoxysilane, 3-aminomethyltrimethoxysilane, 3-aminotrimethoxysilane, 3-aminotriethoxysilane, 3-amino(cyclohexyl)propyltriethoxysilane, 3-amino-(cyclohexyl)propyltrimethoxysilane, 3-amino(cyclohexyl)ethyltriethoxysilane, 3-amino(cyclohexyl)ethyltrimethoxysilane, 3-amino(cyclohexyl)methyltriethoxysilane, 3 -amino(cyclohexyl)methyltrimethoxysilane, 3-[1] amino(cyclohexyl)trimethoxysilane, 3-amino(cylcohexyl)triethoxysilane, trimethoxypropylsilane, triethoxypropylsilane, trimethoxysilane,

3-aminopropyltrimethoxysilane,

N-[3-(trimethoxysilyl)propyl]aniline,

N-[3-(triethoxy-silyl)propyl]aniline,

N-[3-(triethoxysilyl)ethyl]aniline, N^1-

[3-(trimethoxysilyl)propyl]diethylenetriamine,

N-[3-(trimethoxysilyl)propyl]ethylenediamine,

N-[3-(triethoxysilyl)propyl]ethylenediamine,

3-(trimethoxysilyl)propyl methacrylate, 3-(triethoxysilyl)

propyl methacrylate, aminotriphenylsilane,

azidotrimethylsilane, azidotriethylsilane,

azidotripropylsilane, azidotributylsilane,

azidotri-methoxysilane, azidotriethoxysilane,

azidotripropoxysilane, azidotributoxysilane,

bis[3-(trimethoxysilyl)propyl]amine,

N,O-bis(trimethylsilyl)acetamide,

bis(trimethyl-silyl)acetylene,

bis(trimethylsilyl)cyclopentadiene,

1/4-bis(trimethylsilyl)benzene,

N,O-bis(trimethylsilyl)hydroxylamine, bis (trimethylsilyl)

methane, 2 , 3-bis (tritnethylsilyloxy)-1,3-butadiene,

1,2-bis(trimethylsilyloxy)cyclobutene,

1,2-bis(trimethylsilyl)cyclobutene,

1,2,3-bis(trimethylsilyl)cyclobutene,

1,2,3,4-bis(trimethylsilyl)cyclobutene,

bis(trimethylsilyl)-cyclobutene,

1,2-bis(trimethylsilyloxy)ethane,

2,3-bis(tri-methylsilyl)-1-propene, 2,4-bis(trimethyl-silyloxy) pyrimidine, 1,3-bis(trimethylsilyl)urea, O,O-bis(trimethylsilyl)uracil, bis(trimethylsilyl)trifluoroacetamide, (1-cyclohexenyl-1-ethynyl)trimethylsilane, 1-cyclohexenyloxytrimethylsilane, 1-cyclohexyltrimethylsilane, cyclohexyldimethoxysilane, cyclohexyltrimethoxysilane, cyclohexyldiethoxysilane, cyclohexyltriethoxysilane, cyclohexyldimethoxymethylsilane, cycldliexyltrimethoxysilane, cyclohexyldiethoxymethylsilane, cyclohexyltriethoxysilane, cyclohexyldimethoxysilandiol, cyclohexyldiethoxysilandiol, cyclohexyldipropxymethylsilane, cyclohexyldipropxymethylsilandiol, cyclohexyltrichlorosilane, [(1-cyclopro-pyletheneyl)oxy]trimethylsilane, diallyldimethylsilane, diethoxymethylphenylsilane, 3-(diethoxymethylsilyl)propylamine, diethoxymethylsilane, dimethyloctadecyline, ethyltriacetoxysilane, methyltriacetoxysilane, propyltriacetoxysilane,

isopropy-Itriacetoxysilane, butyltriacetoxysilane, isobutyltriacetoxysilane, sec-butyltriacetoxysilane, tert-butyltriacetoxysilane, benzyltriacetoxysilane, phenyltriacetoxysilane, cyclpentadienyltriacetoxysilane, cyclohexyltriacetoxysilane, isopropoxytrimethylsilane, isopropylaminotrimethylsilane, lithium bis(trimethylsilyl)amide, methoxydimethyloctylsilane, methylbis(trimethylsilyloxy)vinylsilane, octyltriethoxysilane, octyltrimethoxysilane, (phenylthiomethyl)trimethylsilane, phenyltriethoxysilane, phenyltrimethoxysilane, poly(dimethylsiloxane) silicon hexaboride, silicon nitride, silicon tetracetate, silicon tetrachloride, silicon tetrafluoride, sodium bis(trimethylsilyl)amide, tetrakis(trimethylsilyl)silane, tetravinylsilane, trichloro-3-chloropropylsilane, trichlorocyclopentysilane, cyclohexyltrichlorosilane, trichlorovinylsilane, 3-(triethoxysilyl)propionitrile, 3-(trimethoxysilyl)propylamine, 3-(trimethoxysilyl)propyl isocyanate, 3-(trimethoxysilyl)propyl thiocyanate, trihexylsilane, triisopropylsilane, (triisopropylsilyl)acetylene (chlorotriisopropylsilane), triisopropylsilylchloride, 1-(triisopropylsilyl)pyrrole,

trimethylsilylacetate, (trimethylsilyl)acetic acid, (trimethylsilyl)acetylene, trimethylsilyl cyanide, (trimethylsilyl)diazomethane, 5-(trimethylsilyl)-1,3-cyclopentadiene, 1-(trimethylsilyl)imidazole, 1-(trimethylsilyl) pyrrolidine, triphenylsilane, 1,1,1-triphenyl-silylamine, triphenylsilylchloride, tris(2-methoxyethoxy)-vinylsilane, 2,5,5-tris(trimethylsilyl)-1,3-cylcopentadiene, tris(trimethylsilyl)borate, tris(trimethylsilyl)amine, tris(trimethylsilyl)germaniumhydride, tris(trimethylsilyl)-methane, tris(trimethylsilylmethyl)borane, tris(trimethylsilyloxy)silane, vinyltrimethoxysilane, vinyltrimethylsilane, trimethylsilyl N-(trimethylsilyl)-car-bamate, triphenylsilylamine, triethoxysilylamine, tributoxysilyamine, tripropoxysilylamine, vinyltrichloro-silane, Vinyltriethoxysilane, vinyl-triisopropoxsilane, vinyltrimethoxysilane, Vinyltriethoxysilane, dimethoxymethylvinylsilane, diethoxymethylvinylsilane, dimethoxyethylvinylsilane, diethoxyethylvinylsilane, dimethylmethoxyvinylsilane, dimethylethoxyvinylsilane,

di-methylpropoxyvinylsilane, dimethylisopropoxyvinylsilane, diethylmethoxyvinylsilane, diethylethoxyvinylsilane, diethylpropoxyvinylsilane, diethylisopropoxyvinylsilane, dimethylethoxy(methylvinyl)silane, dimethoxymethyl(ethylvinyl)silane, diethoxy-methyl(propylvinyl)silane, vinyltrimethylsilane, vinyltriethylsilane, vinyltriphenylsilane, vinyltris(2-butylidenaminooxy)silane, vinyltris(2-methoxyethoxy)silane, vinyltris(2-methylethoxy)silane,,vinyltris(2-ethoxy)silane, vinyltris(trimethylsiloxy)silane, 3-(2-aminoethylamino)propyltrimethoxysilane, 3-aminopropyl-methyl-diethoxysilane, 3-aminopropyltriethoxysilane, 3-aminopropyltrimethoxysilane, 3-aminomethyltriethoxysilane, 3-aminoethyltriethoxysilane, 3-aminopropyltrimethoxysilane, 3-aminomethyltrimethoxysilane, 3-aminoethyltrimethoxysilane, (3-aminopropyl)tris[2-(2-methoxyethoxy)ethoxysilane, amyltriethoxysilane, 1, 3-bis(chloromethyl)-1,1,3,3-tetramethyldisilazane, 1, 3-bis(chloromethyl)-1,1,3,3-tetramethyldisiloxane, 1, 2-bis(chlorodimethylsilyl)ethane, 1,3-bis(3

-cyanopropyl)tetramethyldisiloxane, 1,3-bis(3-cyanopropyl)tetramethyldisilazane, bis(diethylamino)dimethylsilane, bis(dimethylamino)dimethyl-silane, bis (diethylamino)diethylsilane, bis(dimethylamino)diethylsilane, 1,2-bis[(dimethylamino) dimethylsilyl]ethane, 1,2-bis(dimethylsilyl)benzene, 1,2-bis(dimethyl-silyl)cyclohexene, 1, 4-bis(dimethylsilyl)benzene, 1,4-bis(dimethylsilyl)cyclohexene, 1,3-bis(4-hydroxybutyl)-1,1,3,3-tetramethyldisiloxane, 1,3-bis(4-hydroxybutyl)-1,1,3,3-tetramethyldisilazane, bis(N-methylben-zamido)methylethoxysilane, 1,4-bis(trimethylsilyl)butadiyne, N,O-bis(trimethylsilyl) acetimide, N,N-bis(trimethylsilyl) methylamine, N,N-bis(trimethylsilyl)amine, N,N-bis(triethylsilyl)amine, N,N-bis(trimethylsilyl)urea, bis(trimethylsilyl)phosphite, N,O-bis(trimethylsilyl) trifluoroacetimide, tert-butyldimethylsilane, tert-butyldimethylsilanol, (tert-butyldimethsilyl)acetylene, tert-butyldimethylsilyl cyanide, N-(tert-butyldimethylsilyl)dimethylamine, butyldimethylchlorosilane, tert-butyldimethylchlorosilane,

O- (tert-butyldimethyifsilyl)hydroxylamine, 1-(tert-butyldlmethylsilyl)imidazole, tert-butyldiphenylsilyl cyanide, tert-butyldicyclohexylsilyl, cyanide, N-tert-butyltrimethylsilylamine, tert-butyl-trimethylsilyl peroxide, tert-butyl-trimethylsilyl acetate, [2-(cyclohexenyl)ethyl]triethoxysilane, N,N-diethyltrimethylsilylamine, N,N-diethyltriethylsilylamine, N,N-diethyl(trimethylsilylmethyl)amine, diethyl trimethylsilyl phosphite, diphenylmethylsilane, dicyclohexylmethylsilane, diphenylethylsilane, dicyclohexylethylsilane, diphenylsilane, dicyclohexylsilane, dicyclohexylsiladiol, 1,3-diphenyl-1,1,3,3-tertamethyldisilazane, 1,3-diphenyl-1,1,3,3-tertamethyldisiloxane, 1,3-dicyclohexyl-l,1,3,3-tertamethyldisilazane, 1,3-dicyclohexyl-l,1,3,3-tertamethyldisiloxane, 1,3-divinyl-1,1,3,3-tetramethyldisilazane, 1,3-divinyl-1,1,3,3-tetramethyldisiloxane, dodecyltriethoxysilane, 1,1,3,3,5,5-hexamethyltrisilazane, 1,1,3,3,5,5-hexamethyltrisiloxane, methyltriethoxysilane, ethyltriethoxysilane, propyltr^ethoxysilane,

isopropyltriethoxysilane, [1] butyltrimethoxysilane, butyltriethoxysilane, isobutyltriethoxysilane, sec-butyltriethoxysilane, tert-butyltriethoxysilane, hexyltriethoxysilane, (3-isocyanatro-propyl)triethoxysilane, (isopropenyloxy)trimethylsilane, isopropyldimethylchlorosilane, lithium bis(trimethylsilyl)amide, potassium bis(trimethylsilyl)amide, (3-mercap-topropyl)methyldimethoxysilane, (3-mercap-topropyl)triethoxysilane, (3-mercaptopropyl)trimethoxy-silane, (methoxymethyl)trimethylsilane, methoxytrimethylsilane, ethoxytrimethylsilane, [3-(methylamino)propyl]trimethoxysilane, methyldiethoxysilane, 2-methylbenzosilylazole, methyl-octadecyl-dichlorosilane, methyl-octyldimethoxysilane, methyl-octyldichlorosilane, methyl-phenyl-chlorosilane, methyl-phenyl-dichlorosilane, methyl-phenyl-diethoxysilane, methyl-phenyl-dimethoxysilane, (methylthio)trimethylsilane, methyltriactoxysilane, methyltrichlorosilane, ethyltrichlorosilane, methylethoxysilane, ethylethoxysilane, methyltriethoxysilane, ethyltrimethoxysilane, ethyltrie thoxysilane, N-methyl-N-trimethylsilylacetamide,

methylvinyldiethoxysilane, phenyltriethoxysilane, cyclohexyltriethoxysilane, Phenyltrimethoxysilane, cyclohexyltrimethoxysilane, Phenyl(methylene)triethoxy-silane, cyclohexyl(methylene)triethoxysilane, phenyl(methylene)trimethoxysilane, cyclohexyl(methylene) trimethoxysilane, Phenyl-(ethylene)triethoxysilane, cyclohexyl(ethylene)trimethoxysilane, phenyl(ethylene)trimethoxysilane, cyclohexyl (ethylene)trimethoxysilane, phenyltrimethylsilane, phenyltriethylsilane, phenyltripropylsilane, phenyl triisopropyl si lane, phenyltributylsilane, phenyltri-sec-butyTsilane, phenyltri-tert-butylsilane, phenyltri-isobutylsilane, cyclohexyltrimethylsilane, cyclohexyltri-ethylsilane, cyclohexyltripropylsilane, cyclohexyltriisopropylsilane, cyclohexyltributylsilane, cyclohexyl tri-sec-butylsilane, cyclohexyl tri-tert-butylsilane, cyclohexyltriisobutylsilane, Phenyltriethoxysilanediol, cyclohexyltriethoxysilanediol, Phenyltrimethoxysilanediol, cyclohexyltrimethoxysilanediol, phenyltrimethylsilanediol, phenyltriethylsilanediol, phenyltripropylsilanediol, phenyltriisopropylsilanediol,

phenyltributylsilanediol, phenyltri-sec-butylsilanediol, phenyltri-tert-butylsilanediol, phenyltriisobutylsilanediol, cyclohexyltrimethylsilanediol, cyclohexyltriethylsilanediol, cyclohexyltripropylsilanediol, cyclohexyltriisopropylsilanediol, cyclohexyltributyl-silanediol, cyclohexyltri-sec-butylsilanediol, cyclohexyltri-tert-butylsilanediol, cyclohexyltriisobutyl-silanediol, propyltrimethoxysilane, tetramethylsilane, 2, 4, 6, 8-tetramethylcyclotetrasilazane, 1,1,3,3-tetramethyldisilazane, 1,1,3,3-tetramethyldisiloxane, tetramethyltetrasilylfulvalene, trimethylethoxysilane, N-(trimethylsilyl) acetamide, trimethylphenoxylsilane, 1-(trimethylsiloxy)cyclopentene, 1-(trimethylsiloxy)cyclohexene. trimethoxylphenylsilane, 1-(trimethoxylsilyl) cyclopentene, 1-(trimethoxylsilyl) cyclohexene, triethoxylphenylsilane, 1-(triethoxylsilyl)cyclopentene, 1-(triethoxylsilyl) cyclohexene, trimethoxylcyclohexylsilane, (trimethoxylsilyl)cyclopentane, (trimethoxylsilyl) cyclohexane, triethoxylcyclohexylsilane, (triethoxylsilyl) cyclopentane, (triethoxylsilyl) cyclohexane, trimethylsilyl

azide, triethylsilyl azide, tripropylsilyl azide, triisopropylsilyl azide, tributyl azide, triisobutyl azide, tri-tert-butyl azide, tri-sec-butyl azide, triphenyl azide, trimethoxylsilyl azide, triethoxylsilyl azide, tripropoxylsilyl azide, triisopropoxylsilyl azide, tributoxyl azide, triisobutoxyl azide, tri-tert-butoxyl azide, tri-sec-butoxyl azide.

(trimethylsilyl)cyclopentadiene, trimethylsilyl cyanide, (trimethylsilyl)acetontrile, trans-3 -(trimethylsilyl)allyl alcohol, 2-(trimethylsilyl)methanol, 2-(triethylsilyl)ethanol, (trimethylsilyl)methanol, (triethylsilyl)ethanol, triisobutylsilane, 2-(trimethylsilyl)methanol, 2-(trimethylsilyl)ethanol, O-(trimethylsilyl)hdroxylamine, 1-(trimethylsilyl)imidazole, trimethylsilylisocyanate, (trimethylsilyl)methyl acetate, trimethylsilyl methacrylate, (trimethylsilyl)methylamine, N-(trimethylsilylmethyl)urea, 4-(trimethylsilyl)morpholine, 4-(triethoxysilyl)butyronitrile, 1-(trimethylsilyl)pryrrolide, 1-trimethylsilyl-1,2,4-triazole, triphenylsilane, triphenylsilandiol, triphenylsilylamine, tricyclo-hexylsilylamine, phenyldimethoxysilylamine,

methylphenyl-dimethoxysilane, phenyldiethoxysilylamine, cyclohexyl-dimethoxysilylamine, cyclohexyldiethoxysilylamine, dipheny-Imethoxysilylamine, diphenylethoxysilylamine, dicyclohexyl-methoxysilylamine, dicyclohexylethoxysilylamine, cyclohexyl-silyltriamine, cyclohexyl(ethyl)silyltriamine, cyclohexyl(methyl)silyltriamine, benzylsilyltriamine, benzyl(methyl)silyltriamine, diphenylsilyldiamine, phenylethoxysilyldiamine, cyclohexylethoxysilyldiamine, cyclohexyldiethoxysilylamine, cyclohexylmethoxysilyldiamine, cyclohexyl(ethyl)ethoxysilyldiamine, cyclohexyl(methyl)-ethoxysilyldiamine, benzylmethoxysilyldiamine, benzyl-dimethoxysilylamine, tris(trimethylsilyl)amine, tris(trimethoxylsilyl)amine, tris(triethoxylsilyl)amine, tris(trimethylsilyl)borate, tris(trimethylsilyl)methane, tris(trimethylsilyl)ethane, tris(trimethylsilyl)phosphate, tris(trimethylsilyl)phosphine, tris(trimethylsilyl)silane, vinyltriethoxysilane, vinyltrichlorosilane, vinyl-triisopropylsilane, vinyltrimethylsilane, vinyltri-phenylsilane, vintris(2-buytlidenaminooxy)silane, vinyltris(2-methoxyethoxysilane), vinyltris(trimethylsiloxy)silane,

allyldimethylsilane, allyldiethylsilane, diallyldimethylsilane, diallyldiethylsilane, allyoxytrimethylsilane, allyoxytriethylsilane, allylphenylsilicon, tripropylsilane, tris(trimethylsilyl)-silane, pentamethylcyclopentasiloxane, 2,4,6,8,10-pentamethylcyclopentasiloxane, pentamethyldisiloxane, amyltriethoxysilane, vinyltricholorsilane, vinyltriethylsilane, vinyltrimethylsilane, vinyltriphenylsilane, vinyltriethoxysilane, vinyltripropyoxysilane, vinyltrisopropyoxysilane, vinyltri-methoxylsilane, vinyltriphenoxysilane, vinyltributoxysilane, vinyltriisobutoxysilane, vinyltrisecbutoxysilane, vinyltri-tert-butoxysilane, vinyltris(2-butylidenaminooxy)silane, vinyltris(2-methoxyethoxy)silane, vinyltris-(trimethoxysiloxy)silane, N,N-dimethyltrimethylsilyamine, N,N-diethyltrimethylsilyamine, 3,3-dimethyl-1-trimethylsily-1-butyne, 3,3-diethyl-1-trimethylsily-1-butyne, dimethyltrimethylsilylmethylphosphonate, dimethyltrimethyl-silylphosphite, dimethyltritylbromosilane,

dimethyl-vinyl-ethoxysilane, dimethylvinylchlorosilane, diphenyl-methylchlorosilane, diphenylethylchlorosilane, phenyl-dimethylchlorosilane, phenyldiethylchlorosilane, diphenyldi(M-tolyl)silane, 1,2-dimethylsilane, 1,2-dieth'ylsilane, 2 , 2 , 4 , 4 , 6 , 6-hexamethylcyclotrisilazane, N-benzyltrimethylsilylamine, chlorodimethyloctylsilane, trimethyloctylsilane, disiloxane, silicon nitride, disil.ane, dimethylsilanediol, trichlorocyclopentysilane, tris(isopropylthio)silane, chlorotrimethylsilane, chlorodimethylsilane, bis(chloromethyl)dimethylsilane, propyltrichlorosilane, trimethyl(pentafluorophenyl)silane, trichloro(1H,1H,2H,2H-perfluorooctyl)silane, silicon tetraboride, silicon hexa-boride, trimethyl-2-thienylsilane, (4-bromophenyl)trimethyl-silane, 4-(trimethylsilyl)phenol, 5-(trimethylsilyl)-1,3-cyclopentadiene, trimethylsilylmethylmagnesiumchloride, N,N-diisopropyltrimethylsilylamine, dicyclohexyl-methyl-silane, tetracyclohexysilane, 1,1,2,2,3,3,4,4,5,5-decaphenyl-6,6-dimethylcyclohexasilane, trimethylsilylpolyphosphate, trimethylsilylpolyphosphite, including analogues, homologues, isomers and derivatives

thereof.

Additional examples of acceptable silicon derivatives can be found in Silicon Compounds, Register and Review, Petrarch Systems, Inc. (1984), Frontiers of Organosilicon Chemistry, Bassindale, Caspar, The Royal Society of Chemistry, (1991), incorporated herein by reference. Corresponding compounds of germanium, tin, titanium, zirconium, selenium, tellurium, are contemplated in the practice of this invention.

Non-limiting germanium derivative compounds include: decamethylgermaniumocene (bis(pentamethylcyclopentadienyl)germanium), tertbutylgermanium, tetramethylgermanium, tetraethylger-manium, tetrapropylgermanium, tetraisopropylgermanium, tetrabutylgermanium, tetraisobutylgermanium, tetra-tertbutylgermanium, tetra-sec-butylgermanium, tetra-phenylgermanium, phenylgermanium, methylphenylgermanium, methylphenolgermanium, including analogues, homologues, isomers and derivatives thereof.

Non-limiting derivative tin compounds include: deca-methylstannocene (bis(pentamethylcyclopentadienyl)tin), dibutyltin bis(2-ethylhexanoate), dibutyltin diacetate,

dibutyloxotin (dibutyltin oxide), dimethyltin, diethyltin, dipropyltin, diisopropyltin, dibutyltin, diisobutyltin, di-tert-butyltin, di-sec-butyltin, di-phenyltin, tetramethyltin, tetraethyltin, tetrapropyltin, tetraisopropyltin, benzltriphenyltin, allyltributyltin, tetrabutyltin, tetraisobutyltin, tetra-tert-butyltin, tetra-sec-butyltin, tetraphenyltin, tetramethoxytin, tetraethoxytin, tetrapropoxytin, tetraisopropoxytin, tetrabutoxytin, tetraisobutoxytin, tetra-tert-butoxytin, tetra-se'C-butoxytin, tetraphenoxytin, trimethoxymethyltin, triethoxymethyltin, tripropoxymethyltin, triisopropoxymethyltin, tributoxymethyltin, triisobutoxymethyltin, tri-tert-butoxymethyltin, tri-sec-butoxymethyltin, triphenoxymethyltin, dibutyltin dichloride, dibutyltin dilaurate, dibutyltin dimethoxide, dibutyltin diethoxide, -dibutyltin methoxide, dibutyltin ethoxide, tetrabutyltin, tetramethyltin, tetraethyltin, tetrapropyltin, tetra-tert-butyltin, allyldibutyltin, allyldiphenyltin, allyldiphenylstannane, dichlorodiphenyltin, diphenyltin acetate, tributyl-tineacetate, tributyltinechloride, tributyltincyanide, tributyltin ethoxide, tributyltin methoxide, tributyltinhydride,

tributylvinyltin, • triphenyltinchloride, triphenyltinhydroxide, triphenyltinhydride, tributyltin ethoxide, including analogue, homologue, isomer, and derivative thereof.

Non-limiting examples of phosphorus derivative compounds of this invention include: phosphoric acid esters, othrophosphoric acid esters, nuetral phosphate esters, tetrabutylphosphonium hydroxide, allyldiphenylphospine, diphenylphosphine, phenylphosphine, diphenyl phosphate, diphenylphosphine, diphenylphosphinic acid, diphenylethoxyphospine, diphenylmethoxyphospine, diphenylpropoxyphospine, diphenylisopropoxyphospine, diphenylbutoxyphospine, diphenyl-sec-butoxyphospine, diphenyl-tert-butoxyphospine, diphenyl-iso-butoxyphospine, dicyclohexylethoxyphospine, dicyclohexylmethoxyphospine, dicyclohexylpropoxyphospine, dicyclohexylisopropoxyphospine, dicyclohexylbutoxyphospine, dicyclohexyl-sec-butoxyphospine, dicyclohexyl-1ert-butoxyphospine, dicyclohexyl- i so-butoxyphospine, dicyclopentylethoxyphospine, dicyclopentyl-methoxyphospine, dicyclopentylpropoxyphospine, dicyclopen-tylisopropoxyphospine, dicyclopentylbutoxyphospine,

dicyclopentyl-sec-butoxyphospine,

dicyclopentyl-tert-butoxyphospine,

dicyclopentyl-iso-butoxyphospine,

dicyclohexyl(ethyl)ethoxyphospine,

dicyclohexyl(ethyl)-methoxyphospine,

dicyclohexyl(ethyl)propoxyphospine,

dicyclohexyl(ethyl)isopropoxyphospine,

dicyclohexyl(ethyl)butoxyphospine, dicyclohexyl(ethyl)-sec-butoxyphospine, dicyclohexyl(ethyl)-tert-butoxyphospine, dicyclohexyl(ethyl)-iso-butoxyphospine, phenyldiethoxyphospine (diethylpheaylphosphonite), phenyldimethoxyphospine, phenyldipropoxyphospine, phenyldiisopropoxyphospine, phenylHibutoxyphospine, phenyldi-sec-butoxyphospine, phenyldi-tert-butoxyphospine, phenyldiisobutoxyphospine, cyclohexyldiethoxyphospine, cyclohexyldimethoxyphospine, cyclohexyldipropoxyphospine, cyclohexyldiisopropoxyphospine, cyclohexyldibutoxyphospine, eyeloKexyldi-sec-butoxyphospine, cyclohexyldi-tert-butoxyphospine, cyclohexyldi-iso-butoxyphospine, cyclopen-tyldiethoxyphospine, cyclopentyldimethoxyphospine, cyclopentyldipropoxyphospine,

cyclopentyldiisopropoxy-phospine,

cyclopentyldibutoxyphospine,

cyclopentyldi-sec-butoxyphospine,

cyclopentyldi-tert-butoxyphospine,

cyclopentyldiiso-butoxyphospine,

cyclohexyl(ethyl)diethoxyphospine,

cyclohexyl-(ethyl)dimethoxyphospine,

cyclohexyl(ethyl)dipropoxyphospine, .cyclohexyl(ethyl)-diiso propoxyphospine, cyclohexyl(ethyl)dibutoxyphospine, cyclohexyl(ethyl)di-sec-butoxyphospine, cyclohexyl-(ethyl)ditert-butoxyphospine, cyclohexyl(ethyl)diiso-butoxyphospine, dimethylmethylphosphate, diethylmethyl-phosphate, diethylethylphosphate, dimethylethylphosphate, ethylenebis(diphenylphosphine), methyldichlorophosphite, methyldichlorophosphate, methyldichlorophosphine, methyldiphenylphosphine, propylphosphonic anhydride, dimethylphosphine, diethylphosphine, dimethylphosphine, dipropylphosphine, diisopropylphosphine, dibutylphosphine, diisobutylphosphine, disecbutylphosphine, di-t-butyl-phosphine, diphenylphosphine, diphenylphosphate, diphenylphosphineoxide, diphenylphosphine oxide,

diphenyl-phosphineselenide, dis(diethylamino)phosphine, dis(dimethylamino)phospine, dis(2-ethylhexyl)phosphate, dis(dimethylsilyl)phosphate, dis(dimethylsilyl) phosphite, di(toly)phosphine, di(o-toly)phosphine, di(m-toly)phosphine, •di(p-toly)phosphine, di(toly)phosphite, di(o-toly)phosphite, di(m-toly)phosphite, di(p-toly)phosphite, di(toly)phosphate, di(toly)hydrophosphate, di(toly)phosphonic acid [(CH3C6H4)2P(OH)], mono(toly)phosphonic acid [(CH3C6H4)-P(OH)2], diethylphenylphosphine, diethylphenylphosphite, dipropylphosphite, diisopropylphosphite, dibutylphosophite, diisobutylphosophite, di-sec-butylphosophite, di-tert-butyl-phosophite, diphenylphosphite, allydiphenylphosphonium, al-lydiphenylphosphonium hydride, allydiphenylphosphonium hydroxide, allydiphenylphosphonium chloride,

dimethylphosphoramidous dichloride, hexamethylphosphoramide, hexamethylphosphorus diamide, hexamethylphosphorus triamide, hexamethylphospophorimidic triamide, trimethylphosphine, trimethylphospate, trimethylphosphite, triethylylphosphite, tripropylphosphite, triisopropylphosphite, tri-butyl-phosphite, tri-iso-butylphosphite,

tri-sec-butylphosphite, tri-tert-butylphosphite, triphenylphosphite, dimethylphosphite, diethylphosphite, diropylphosphite, diisopropylphosphite, dibutylphosphite, diisobutylphosphite, di-sec-butylphosphite, di-tert-butylphosphite, diphenyl-phosphi'te,, ditnethylethylphosphine, dimethylethylphosphate, dimethylethylphosphite, diethylmethylphosphite, dipropylmethylphosphite, diisopropylmethylphosphite, di-butyl-methylphosphite, di-iso-butylmethylphosphite, di-sec-butylmethylphosphite, di-tert-butylmethylphosphite, diphenylmethyl phosphite, dimethylphosphonate, diethylphosphonate, dipropylphosphonate, diisopropyl-phosphonate, di-butyl-phosphonate, di-iso-butylphosphonate, di-sec-butylphosphonate, di-tert-butylphosphonate, diphenylphosphonate, dimethylmethylphosphonate, dimethylethylphosphonate, diethylmethylphosphonate, dipropylmethylphosphonate, diisopropylmethylphosphonate, di-butyl-methylphosphonate, di-iso-butylmethylphosphonate, di-sec-butylmethylphosphonate, di-tert-butylmethylphosphonate, diphenylmethyl phosphonate, diethylethylphosphonate, dipropylethylphosphonate, diisopropylethylphosphonate, di-butyl-ethylphosphonate,

di-iso-butylethylphosphonate, di-sec-butylethylphosphonate, di-tert-butylethylphosphonate, diphenylethyl phosphonate, dimethylcarbophosphonate, diethylcarbophosphonate, dipropylcarbophosphonate, diisopropylcarbophosphonate, di-butyl-phosphonate, di-iso-butylcarbophosphonate, di-sec-butylcarbophosphonate, di-tert-butylcarbophosphonate, diphenylcarbophosphonate, dimethylmethylcarbophosphonate, dimethylethylcar-bophosphonate, diethylmethylcarbophosphonate, dipropylmethylcarbophosphonate, diisopropylmethylcarbophosphonate, di-butyl-methylcarbophosphonate, di-iso-butylmethylcarbophosphonate, di-sec-butylmethylcarbophosphonate, di-tert-butylmethyl-carbophosphonate, diphenylmethyl phosphonate, diethylethylcarbophosphonate, dipropylethylcarbophosphonate, diisopropylethylcarbophosphonate, di-butyl-ethylcarbophosphonate, di-iso-butylethylcarbophosphonate, di-sec-butylethylcarbophosphonate, di-tert-butylethylcarbophosphonate, diphenylethyl

phosphonate, dimethylphospite, dimethylphosphite, trimethyl phosphonoacetate, trimethyl 2-phosphonoacrylate, trimethyl phosphonoformate, trioctylphosphine oxide, triphenyl phospate, triphenylphosphine, triphenylphosphine oxide, triphenylphosphine-copper hydride, triphenylphosphine hydrobromide, triphenylphosphine dibromide, triphenylphosphine oxide, triphenylphosphine selenide, triphenylphosphine sulfide, tripiperidinophosphine oxide, tris(2-ethylhexyl)phosphate, tris(dimethylamino)phosphine, tris(hydroxymethyl)aminomethane phosphate, tris(trimethylsilyl)phosphate, tris(trimethylsilyl)phosphite, tri (toly)phosphines' (e.g. tri(o-toly)phosphine, tri(m-toly)phosphine, tri(p-toly)phosphine), tri (toly) phosphite (e.,g. tri (o-toly) phosphite, tri(m-toly)phosphitfe, tri(p-toly)phosphite), tri(toly)phosphate, tri(toly)hydrophosphate, tri(toly)phosphonic acid [(CH3C6H4)3P(OH)2] , bis(2-ethylhexel) phosphite, diallyphenylphosphine, dibenzylphosphite, dibenzylphosphate, dibutyl phosphite, dimethyl methylphosphonate, dimethyl methylphosphine, dimethyl methylphosphonite, dimethyl-phenylphosphine, dimethylphenylphosphonite,

dimethylphenyl-phosphite, dimethylphosphinic acid, dimethyl(trimethylsilyl-methyl)phosphonate, dimethyl trimethylsilyl phosphite, dimethyl trimethylsilyl phosphonate, ethyldiphenyl-phosphonite, diphenyl(2-methoxyphenyl)phosphine, manganese (II) hydrogen phosphite, disodium fluorophosphate, disodium fluorophosphite, disodiumhydrogenphosphite, trisodium phosphate, trisodium phosphite, dipotassiium fluorophosphate, dipotassium fluorophosphite, tripotassium phosphate, tripotassium phosphite, ethyldiphenylphoSphine, ethyldiphenylphosphini.te, ethyldiphenylphosphonate, methyldiphenylphosphine, methyldiphenylphosphinite, methyldiphenylphosphonate, phenylphosphine, phenylphosphonic acid, phenylphospate phosphorus acid, phosphoric acid, phosphorus trichloride, phosurea, phosphorus trisulfide, tributyl phosphate, tributylphosphine, tri-tert-butylphosphine, tributylphosphine oxide, tributylphosphite, tris (2,4-di-tert-butylphenyl)phosphite, tris (nonlphehyl)phosphite, phosphorous acid triphenylester with propane 1,3-diol, tris(2,2,2-trifluoroethyl)phosphite, tris(2-chloroethyl)phosphite, tris(1-chloroethyl)phosphite, trichlorophosphite, tris(tridecyl)phosphite,

isooctyldiphenylphosphite, diisodecylphenylphosphite, triethyl 4-phosphonocrotonate, trimethyl 4-phosphonocrotonate, triethylphosphonoacetate, trimethyl-phosphonoacetate, trimethyl 2-phosphonobutyrate, triethyl 2-phosphonobutyrate, trimethylphosphonoformate, triethylphosphonoformate, trimethylphosponopropionate, trimethylphosponopropionate, tricyclohexylphosphite, tricyclohexylphophine, triethylphosphine, triethylphosphite, trimethylphosphine, triethylphosphate, trimethylphosphate, tripropylphosphate, triisopropylphosphate, tributyl-phosphate, triisobutylphosphate, tri-sec-butylphosphate, tri-tert-butylphosphate, triphenylphosphate, dimethylphosphate, diethylphosphate, dipropylphosphate, diisopropylphosphate, dibutylphosphate, diisobutylphosphate, di-sec-butylphosphate, di-tert-butylphosphate, diphenylmethylphosphate, diphenylethylphdsphate, diphenylpropylphosphate, diphenylisopropylphosphate, dimethylethylphosphate, diethylmethylphosphate, dipropylmethylphosphate, diisopropylmethylphosphate, di-butyl-methylphosphate, di-iso-butylmethylphosphate, di-sec-butylmethylphosphate, di-tert-butylmethylphosphate, diphenylmethyl phosphate, triethylphosphoramide,

trimethylphosphoramide, tripropylphosphoramide, triisopropylphosphoramide, tributylphosphoramide, tri-isobutylphosphoramide, tri-sec-butylphosphoramide, tri-tert-butylphosphoramide, triphenylphosphoramide, dimethoxyphosphorusamide (CH3O)2PNH2), diethoxyphosphorusamide, dipropoxyphosphorusamide, diisopropoxyphosphorusamide, dibutoxyphosphorusamide, di-isobutoxyphosphorusamide, di-sec-butoxyphosphorusamide, di-tert-butoxyphosphorusamide, diphenoxyphosphorusamide, dimethylphosphoramide (CH30)2PONH2), diethylphosphoramide, dipropylphosphoramide, diisopropyIphosphoramide, dibutyl-phosphoramide, diisobutylphosphoramide, di-sec-butylphosphoramide, di-tert-butylphosphoramide, diphenylphosphoramide, dimethylethylphosphoramide, diethylmethylphosphoramide, dipropylmethylphosphoramide, diisopropylmethylphosphoramide, di-butyl-methyl-phosphoramide, di-iso-butylmethylphosphoramide, di-sec-butylmethylphosphoramide, di-tert-butylmethylphosphoramide, diphenylmethyl phosphoramide, triethylcarbophosphate, trimethylcarbophosphate, tripropylcarbophosphate,

triisopropylcarbophosphate, tri-butyl-phosphate, tri-iso-butylcarbophosphate, tri-sec-butylcarbophosphate, tri-tert-butylcarbophosphate, triphenylcarbophosphate, dimethylcarbophosphate, diethylcarbophosphate, dipropylcarbophosphate, diisopropylcarbophosphate, dibutylcarbophosphate, diisobutylcarbophosphate, di-sec-butylcarbophosphate, di-tert-butylcarbophosphate, diphenylcarbophosphate, dimethylethylcarbophosphate, diethylmethylcarbophosphate, dipropylmethylcarbophosphate, diisopropylmethylcarbophosphate, di-butyl-methylcarbophosphate, di-iso-butylmethylcarbophosphate, di-sec-butylmethylcarbophosphate, di-tert-butylmethylcarbo-phosphate, diphenylmethyl phosphate, dimethylvinylphosphate, diethylvinylphosphate, dipropylvinylphosphate, diisopropylvinylphosphate, dibutylvinylphosphate, diisobutylvinylphosphate, di-sec-butylvinylphosphate, di-tert-butylvinylphosphate, diphenylvinylphosphate, triisobutylphosphine, triisodecylphosphite, triisopro-pylphosphite, dibenzyldiethylphosphoramidite, dibenzyl-diisopropylphosphoramidite, dibenzylphosphite, dibenzylphosphate, tris(tridecyl)phosphite,

tritolylphosphate, tritolyphophine, tritolyphosphite, tricyclohexylphosphine, aliminum phosphate, 1,2-bis(di-phenylphosphino)propane, trioctylphosphine oxide, trioctyl-phosphine, dichloromethylphosphine, dichlorophosphineoxide (C12PO), ethyldichlorophosphite, tetraethylpyrophosphite, benzyldiethylphosphite, benzyldiethoxyphosphorus, , cyclohexyldiethoxyphosphorus, dibenzyldiisopropylphosphoramite (dissopropyl-phosphoraramidous acid dibenyl ester), di-tert-butyl diisopropylphosphoramidite, tert-butyl tetraisopropyl-phosphorodiamidite, (+/-)-1-amino-cis-3-phosphonocyclopentanecarboxlic acid, diallyl diisopropyl-phosphoramide, tert-butyl tetraisopropylphosphorodiamite, (1-amino-butyl)-phosponic acid, 6-amino-1-hexyl phosphate, 1-aminoethylphosponic acid, 2-aminoethyl dihydrogenphosphate, 2-aminoethylphosponic acid, methyl N,N,N'-tetraisopropylphosphordiamidite, hexamethyl-phosphoramide [(CH3)2N]3PO, hexamethylphosphortriamidite [(CH3)2N]3P, diethyl 4-aminobenzylphosphonate, diethyl 4-aminobenzylphosphite, diethylbenzylphosphonate, diethylbenzylphosphite,

tetraethylbenzylphosphonate, diethyl (pyrrolidinomethyl)phosphonate, diethyloxyphosphinyl isocyanate, 6-amino-1-hexylphosphate, diethyloxyphinyl isocyanate, diethylcyanomethylphosphonate, diethylveinylphosphonate, dioctylphenylphosphonate, ethylphenylphosphinate, ethylphenylphosphonic acid, methyl-phosphonic acid, ethylphosphonic acid, propylphosphonic acid, isopropylphosphonic acid, butylphosphonic acid, sec-butylphosphonic acid, tert-butylphosphonic acid, isobutylphosphonic acid, phenylphosphonic acid, phenylphosphoric acid, phenylphosphinic acid, methylphenyl-phosphinate, methylphenylphosphine, aminomethylphosphonic acid, vinylphosphonic acid, hypophosphorus acid, sodium hypophosphate, sodium dihydrogenphosphate, fluorophosphoric acid, ammonium hydrogenphosphate, ammonium hydrogen-phosphite, ammonium hydrogenphosphine, lithiumdihydrogen-phosphate, triphenylphosphineselenide,
phosphoric acid, phosphorus oxychloride, phosphorus pentasulfide, metaphosphoric acid, phenylphosphate disodium salt,
nitrilotris(methylene)triphosphonic acid, ethylenephosphite,

ammonium salt benzylphosphite, potassiumhexafluorophosphate, diethyltrimethylsilylphosphite, diethyl(trichloroethyl)phos-ponate, dimethyl(trimethylsilyl)phosphite, tris(trimethylsilyl)phosponate, 2-chloro-1,3,2-dioxaphospolane, 2-chloro-1,3,2-dioxaphospholane-2-oxide, dimethylmethylphosphonate, diethylmethylphosphonate, dimethylethylphosphonate, diethylethylphosphonate, ethylmethylphosphonate, 2-carboxyehtylphosphonic acid, 2,2,2-trichloro-l,1-dimethylethyldichlorophosphite, biS'(2-chloroethyl)phosphoramidic dichloride, butyldichlorophosphite, butylphosphonic dichloride, tert-butylphosphonic dichloride, tert-butyldichlorophosphine, trime't'hylphosphonof ormate, trimethylpropionamide, trimethylpropionanilide, diethylchlorophosphate, diethylchlorophosphite, chlorodiethylphosphine, diethylphosphoramidous dichloride, diethylthiophosphate, sodiutn salt diethylthiophosphate, diethylphosphoramidate, dimethylphosphoramidate, tetramethylphosophorodiatnidic chloride, tetramethylphosphonium chloride, diethylcyanophosphate, diethylcyanophosphonate,

diethyl-cyanomethylphosphonate, diethoxyphosphinyl isocyanate, O,O'-diethylmethylphosphonothioate, diethylmethylphosphonate, diethyl(hydroxymethyl)phosphonate, dimethyltrimethylsilyl-phosphite, 1-ethyl-3-methyl-1H-imidzolium hexaflurophosphite, diethylcyanmethylphosphonate, phosphorus napthenate, methylphenylphospholene, methylphenyl-phosolenedichloride, (aminobenzyl)phosphonic acid (e.g. (4-aminobenzyl)phosphonic acid), cyclophosphamide, pinacolylmethylphosphonate, diethyl(ethylthio-methyl)phosphonate, 2-furyl tetramethylphosphorodiamidite, diisopropylcyanomethylphosphate, 1,3,5-tris(2-hydroxyethyl)-cyanuric acid, tris(2,4,-di-tert-butylphenyl)phosphite, tris(tridecyl)phosphite, tris(nonylphenyl)phosphite, phosphorus anyhydride, phospham, phosphonium chloride, phosphoniumsulfide, phosphoniumsulfate, phosphoramide, phor-phoramidite, metaphosphoramide, phosphorus chloride(di)nitride, phosphorus cyanide, phosphorus trifluoride, phosphorus pentafluoride, phosphorus oxybromide, phosphorus pentaselenide, phosphorus t.rioxide, phosphorus

sesquioxide, phosphorus tri(tetra-)selenide, phosphorus thiochloride, phosphorus thiocyanate, hypophosphorus acid, metaphosphorus acid, orthophosphorus acid, pyrophosphorus acid, phosphine, phosphorus nitride, phosphorus sesquisulfide, including analogues, homologues, isomers and derivatives thereof. The corresponding compounds of arsenic, antimony and bismuth are contemplated.

Non-limiting antimony derivative compounds include: alkyl antimony compounds, trialkyl compounds, cyclomatic/ring system compounds, including, trimethylantimony, triethylantimony, tripropylantimony, triisopropylantimony, tributylantimony, triisobutylantimony, tri-tert-butylantimony, tri-sec-butylantimony, tri-phenylantimony, phenylantimony, tri(methylphenyl)antimony, triphenylantimony oxide, tri(methylphenol)antimony, antimony ethoxide, pentamethylantimony, phenyldimethylantimony, , phenylstibinic acid, tetramethyldistibyl, tributylstibene, triethylantimony, triethylantimony chloride, trimethylantimony, triphenylantimony, triphenylantimony dichlorlde, triphenylantimony sulfide, including analogue, homologue, isomers and derivative thereof.

Non-limiting arsenic derivative compounds include:

alkyl arsenic compounds, dialkyl compounds, cyclomatic/ring system compounds including, diethylarsine, dimethylarsine, diphenylarsine, ethylarsine, methylarsine, oxophenylarsine, triethylarsine, triethylarsine, tripropylarsine, triisopropylarsine, tributylarsine, triisobutylarsine, tri-tert-butylarsine, tri-sec-butylarsine, tri-phenylarsine, phenylarsine, tri(methylphenyl)arsine, triphenylarsine oxide, tri (methylphenol)arsine, phenylarsenic acid, phenylcyclotetramethylenearsine, arsenobenzene, cacodylic acid, cacodyl oxide, cacodyl amide, carbasone, arsanilic acid, ethanearsonic acid, methanearsonic acid, nitarsone, benzenearsonic acid, propyl arsonic acid, dimethylchlor-arsine, dimethylcyanoarsine, diphenylarsinic acid, diphenylchloro-arsine, ethylarsonic acid, methylarsine, methyldichloroarsine, phenylarsine, phenyldimethylafsine, tetraethyldiarsine, tetramethylbiarsine, tribenzylarsine, trimethylarsine, triethylarsine, tributyl arsine, tri-isobutyl arsine, triphenyl arsine, including analogue, homologue, isomers and derivative thereof. See Organo Arsenial Compounds, Raiziss, Gavron, American Chemical Society (1923) and related/subsequent editions, volumes or supplements, incorporated by reference. Corresponding compounds of

phosporus, antimony, bismuth are also contemplated herein and incorporated by reference.

Non-limiting bismuth derivative compounds include: alkyl bismuth compounds, dialkyl compounds, cyclomatic/ring system compounds including, triphenylbismuth, triphenylbismuth carbonate, diph'enylbismuthine, methylbismuthine, triethylbismthine,. trimethylbismthine, triphenylbismuthine, tri-n-propylbismuth, including analogue, homologue, isomers and derivative thereof.

Non-limiting potassium derivative compounds of this invention include: potassium bis(dimethylsilyl)amide, potassium acetamide, potassium bis(trimethylsilyl)amide, oxamic acid, P-aminosalicylic acid potassium salt, potassium salt 5-nitroorotic acid, potassium D-gluconate, potassium hexacyanoferrate(III) ($K3Fe(CN)6$), potassium diphenylphosphide, potassiumetherate, potassium acetate, potassium acetate acid, potassium salt acetic acid, potassiumbenzamide, potassium azide, potassium antimonide, potassium orthoarsenate, potassium orthoarsenite, potassium meta-arsenite, potassium diborane, potassium pentaborate, potassium dihydroxy diborane, potassium borohydride, potassium anilide, potassium cadium iodide, potassium chloride,

potassium calcium chloride, potassium carbide, potassium carbonate, potassium hydrogen carbonate, potassium carbonate, potassium alkyl carbonates (alkyl potassium carbonates), potassium methyl carbonate, potassium ethyl carbonate, potassium propyl carbonate, potassium isopropyl carbonate, potassium carbonyl, potassium cobalt (II) cyanide, potassium cobalt (III) cyanide, potassium cobaltinitrite, potassium cynomanganate (II), potassium cynomanganate (III), potassium citrate, potassium ferricyanide, potassium ferrocyanide, potassium hydride, potassium hydroxide, potassium manganate, potassium permanganate, potassium methionate, potassium napthenate, potassium nitride, potassium nitrate, potassium nitrite, potassium nitrophenoxide, potassium nitrobenzene (e.g. potassium-p-nitrobenzene), potassium oleate, potassium oxalate, potassium oxalatoferrate (II), potassium oxalatoferrate (III), potassium monoxide, potassium oxide, potassium peroxide, potassium mono-orthophosphate, potassium hypophosphite, potassium prthophosphite, potassium hydroxoplumbate, potassium rhodium cyanide, potassium selenj.de, potassium selenite, potassium selenocynate, potassium selenocyanoplatinate, potassium disilicate, potassium metasilicate, potassium sodium carbonate, potassium sodium

ferricyanide, potassium hydroxostannate, potassium disufide, potassium hydrosulfide, potassium pentasulfide, potassium tetrasulfide, potassium trisulfide, potassium telluride, potassium thioarsenate, potassium thioarsenite, potassium trithiocarbonate, potassium thiocyanate, potassium amide, potassium salt (E,E)-2,4-hexadienoic acid, dipotassium fluorophosphate, dipotassium fluorophosphite, tripotassium phosphate, tripotassium phosphite, potassium perchlorate, propanoic acid potassium salt, potassium formate, potassium cyanate, potassium hexacyanocobaltate (III), potassium hypophosphite, potassium hexaflurorsilicate, potassium nitroprusside, potassium phenoxide, Shell Chemical's "SparkAid or SparkAde," potassium phosphate (dibasic, monobasic, tribasic), potassium salicylate, potassium selenide, potassium tetracyanonickelate (II) , potassium tetrafluoroborate, potassium xanthogenate, potassium -p-aminobenzoate, potassium copper ferrocynanide, potassium cupric ferrocyanide, potassium hexafluorophosphate, potassium hexanitricobaltate III, potassium naphthenate, potassium-B-naphthoxide,potassium polysulfide, potassium -sodium phosphate, potassium stearate, potassium sulfide, potassium sulfite, potassium sulfate, potassium thiocyanate, potassium xanthate,

potassium fluorosilicate, N-potassiumethylene-diamine, oxalic acid dipotassium salt, potassium beta-hydropyruvic acid, potassium 1,1-dimethylurea, potassium 1, 1-diethylurea, potassium 1,1-diepropylurea, potassium xanthate, potassium ethylxanthate, potassium methylxanthate, potassium salt thiophenol, potassiumaluminum-tri-tert-butoxlde, potassium ferrosilicon, triphenylmethylpotassium, methylpotassium, ethylpotassium, potas-siumethynyl(acetylide), propylpotassium, isopropylpotassium, butylpotassium, isobutylpotassium, secbutylpotassium, tertbutylpotassium, pentapotassium, hexylpotassium, heptapotassium, amylpotassium, isoamylpotassium, benzylpotassium, dimethylbenzylpotassium, tolylpotassium, dodecylpotassium, cyclopentadienylpotassium, methylcyclopentadienylpotassium, cyclohexylpotassium, potassiumheptyl, potassiumdodecyl, potassium tetradecyl, potassium hexadecyl, potassium octadecyl, phenylpotassium, potassium o-tolyl, potassium m-tolyl, potassium p-tolyl, potassium-p-chlorophenyl, potassium p-bromophenyl, potassium potassium o- anisyl, potassium m-anisyl, potassium p-anisyl, potassium diethoxyphenyl, potassium dimethoxyphenol, potassium m-cumyl, potassium p-ethoxyphenyl, potassium m-dimethylaminophenyl, potassium 9-flourene, potassium

a-napthyl, potassium b-napthyl, potassium p-phenylphenyl, potassium 9-phenylanthryl, potassium 9-anthryl, potassium 9-methylphenanthryl, potassium pyridyl, potassium 2-pyridyl, potassium 3-pyridyl, potassium 6-bromo-2-pyridyl, potassium 5-bromo-2-pyridyl, potassium dibenzofuryl, potassium 3-quinoyl, potassium 2-lepidyl, potassium triphenylmethyl, potassium 2,4,6-trimethylphenyl, potassium 2,4,6-triisopropylphenyl, potassium 2,3,5,6-tetraisopropylphenyl, potassium tetrabutylphenyl, thiophenedipotassium, toluenedipotassium, diphenylethylenedipotassium, p.otassium-amylethynyl, potassiumphenylethynyl, potassiummethoxybromophenyl, potassium phenylisopropyl, potassium tetraphenylboron, potassium tetramethylboron, potassium a-thienyl, potassium m-trifluoromethylphenyl, phenylethynylpotassium, 3-furylpotassium, phenylisopropylpotassium, dibenzofuranylpotassium, potassium dimethyl-benzyl, potassium selenocyanate, potassium trimethylsilanolate, diphenylphosphide, potassium benzoate, potassium tert-butyl carbonate, potassium azide, di-potassiumcyanamide, potassium cyanide, potassium dicyanamide, cyclohexanebutyric acid potassium salt, cyclohexane acid potassium salt,

cyclopentadientylpotassium, potassium tri-tert-butoxyaluminum hydride, potassium triethylborohydride, potassium trimethylborohydride, potassium tripropylborohydride, potassium triisopropylborohydride,•potassium tributylborohydride, potassium triisobutylborohydride, potassium tri-sec-butylborohydride., potassium tri-tert-butylborohydride, potassium trisiamylborohydride, potassium chlorate, potassium tert-butoxide, potassium sec-butoxide, iso-butoxide,, potassium antimonate, potassium diphenylphosphide, potassium' bis(trismethylsilyl) amide, tripotassium, phosphite,, potassium selenocyanate, potassium tri-sec,-butylborohydr/ide, potassium triethylsilanolate, potassium thiocyanate, potassium acetylide, potassium chlorate, potassium salicylate, potassium di-potassium tetracarbonylferrate, potassium tetraphenylborate, potassium triethylborohydride, po/tassium triacetoxyborohydride, potassium triphenylborane, potassium hydroxide, potassium diphenylphosphide, potassium methoxide, potassium ethoxide, potassium tri-sec-butylborohydride, tri-tert-butylborohydride, potassium triethylborohydride, potassium triphenylborohydride, potassium

trisiamylborohydride, potassium metavanadate, potassium cyclohexanebutyrate, potassium hexachloroplatinate, pptassium thiocyanate, potassium selenocyanate, potassium cyanate, potassium floride, potassium hexafluoroantimonate, potassium hexafluoroaluminate, potassium hexafluoroarsenate< potassium hexafluorosilicate, potassium hexacyano-cobalt (II) ferrate (II), dipotassiumhexacyanocobalt(II)ferrate(II), potassium hexa-fluorotitanate, potassium hexaf luorozirconate, potassium hexahydroxyantimonate, potassium hexachlororuthenate, potassium hexachloropalladate, potassium formate, potassium tetracyanonickelate, potassium tetrafluoroaluminate, potassium tetrafluoroborate, potassium thioacetate, L-glutamic acid monopotassium salt, fumaric acid potassium salt, oxamic acid potassium salt, potassium salt diphenyl-phospane, P-aminobenzoic potassium salt, aminobenzole acid potassium salt, alpha-napthaleneacetic acid potassium salt, dipotassium salt 2,6-naphthalenedicarboxlic acid, potassium cyclcohexanetherate, potassium phthalimide, P-amino-salicylic acid potassium salt, potassium salt 3,5-dimethylcyclohexyl sulfate, indolebutyric acid potassium salt,indole-3-butyric acid potassium salt, potassium diphenylphosphide, potassium dimethylsilanolate, potassium,

triethylborohydride, potassium propoxide, potassium isopropoxide, potassium butoxide, potassium sec-butoxide, potassium pentoxide, potassium tert-pentoxide, potassium hydrogenphthalate, potassium oxalate, potassium hydrogen-sulfate, monopotassium acetylenedicarboxylic acid, potassium pyrophosphate, potassium dihydrogenphosphate, potassium hexoate (potassium salt hexoic acid), potassium diphenylphosphide, potassium trimethylsilonalate, potassium phthalic acid, P-aminobenzoic acid potassium salt, monopotassium L-aspartic acid, tetraphenyldipotassium (C6H5)2CK2C(C6H5)2, potassiumethylphenyl (KCH2C6H5), potassium bromate, potassium chromate, potassium hydrogenphospate, monpotassium salt D-shaccharic acid, Dl-asparatlc potassium salt, (R)-alpha-hyroxymethylaspartic acid potassium salt, potassium fluoride, potassium, ibdate, potassium -salt ethyl malonate, potassium thioacetate,, potassium phenol, potassium salt aminobenzoic acid, potassium aminophenol salt, potassium cyclohexenol, potassium methylcyclohexenol, potassium cyclopropanol, potassium methylcyclopropanol, potassium cyclobutanol, potassium methylcyclobvttanol, potassium methylcyclopentanol, potassium cyclopentanol, potassium cyclohexenol, potassium

methylcyclohexenol, potassium dimethylcyclohexenols (e.g. potassium 3,5-dimethylcyclohexanol, potassium 2,3-dimethylcyclohexanol, potassium 2,6-dimethylcyclohexanol, potassium 2,5-dimethylcyclohexanol, 3,5-dimethylcyclohexanol), potassium o-ethylxanthic acid, monopotassium salt 2-ketoglutaric acid, dipotassium salt, ketomalonic acid, potassium salt lactic acid, dipotassium thiosulfate, potassium antimony tartrate, potassium dichloroacetate, potassium dimethylacetate, potassium diethylacetate, potassium dipropylacetate, potassium metaborate, potassium tetraborate, potassium tetrachloro-cuprate, potassium acetoacetate, potassium diisopropylamide, potassium diethylamide, potassium dimethylamide, potassium bis(dimethylsilyl)amide, dipotassium phthalocyanine, dipotassiumtetrabromocuprate, dipotassium tetrabromonickelate, dipotassiumtetrachloromanganate, dipotassiumbutadiyne, potassium cyclopentadienide, potassium dicyclohexylamide, potassium diethylamide, potassium dimethylamide, potassium dipropylamide, potassium diisopropylamide, potassium thexylborohydride, potassium tri-tert-butoxyaluminohydride, potassium trimethyl-silyl)acetylide, potassium triethylsilyl)acetylide,

potassium trist(3-ethyl-3-pentyl)oxy]aluminohydride, (phenylethynyl)potassium, 2-thienylpotassium, potassium diethyldihydroaluminate, potassium dimethyldihydroaluminate, potassium aluminum hydride, potassium bifluoride, potassium biphenyl, potassium biselenite, potassium bis (2-methoxyethoxy)aluminum hydride, potassium bismuthate, potassium borate, potassium chlorite, potassium cobaltnitrite, potassium cyanoborohydride, potassium cyclopentadienide, potassium dicyanamide, potassium hexametaphosphate, potassium hexanitrocolbaltate, potassium hydrogenphosphite, potassium hydrogenselenite, potassium hydrogensulfite, potassium hydrosulfite, potassium hypochloride, potassium metaarsenite, potassium metabisulfide, potassium metaperiodate, potassium methacrylate, potassium nitroferricyanide, oxybate, potassium pentamethylcyclopentadienide, potassium phenolate, polyphosphate, potassium polyphosphite, potassium propionate, potassium pyrophosphate, potassium selenate, potassium selenite, potassium tetrachloroaluminate, potassium thiomethoxide, potassium thiosulfate, potassium thiosulfide, potassium thiosulfite, potassium triactoxyborohydride, potassium trimethylsilonate, potassium triethylsilonate,

potassium tris(l-pyra-zoly)borohydride, including analogues, homologues, isomers and derivatives thereof. Corresponding compounds of rubidium, caesium (cesium), francium are contemplated in the practice of this invention.

Non-limiting derivative magnesium compounds contemplated by this invention include: alkyl manganese compounds, dialkyl magnesium compounds, magnesium ethylate (ethoxide), magnesium methoxide, dimethylmagnesium, diethylmagnesium, dipropylmagnesium, diisopropylmagnesium, dibutylmagnesium, ditertbutylmagnesium, di-iso-butylmagnesium, di-sec-butylmagnesium, diphenylmagnesium, methylmagnesium chloride, methylmagnesium iodide, magnesium methylcarbonate, magnesium hydroxide, magnesium anthracene dianion, bromomagnesium isopropylcyclohexylamide, methylmagnesium bromide, methylmagnesium chloride, ethylmagnesium chloride, magnesium floride, magnesium chloride, butylmagnesium chloride, isopropylmagnesium chloride, cyclopentylmagnesiumhydride, cyclopentylmagnesium-hydroxide, cyclopentylmagnesiumchloride, cyclopentylmagnesiummethyl, cyclopentylmagnesiumethyl, cyclopentylmagnesiummethylol, cyclopentylmagnesiumethylol, cyclopentylmagnesiummethoxy, cyclopentylmag-nesiumethoxy,cyclohexylmagnesiumhydride,

cyclohexylmagnesiumhydroxide, cyclohexylmagnesiumchloride, cyclohexylmagnesiummethyl, cyclohexylmagnesiumethyl, cyclohexylmagnesiummethylol, cyclohexylmagnesiumethylol, cyclohexylmagnesiummethoxy, cyclohexylmagnesiumethoxy, tert-butylmagnesium chloride, isobutyl-magnesium chloride, allymagnesium chloride, benzylmagnesium chloride, benzylmagnesium hydride, benzylmagnesium ethylate, benzylmagnesium methylate, benzylmagnesium ethoxy, benzyl-magnesium methoxy, magnesium acetate, magnesium alkyl carbonates, magnesium methyl carbonate, magnesium ethyl carbonate, magnesium isopropyl carbonate, trimethylsilylmethyl magnesium chloride, magnesium acetate tetrahydrate, methylmagnesium isopropylcyclo-hexylamide, magnesium pyrophosphate, phenylethynylmagnesium bromide, methylphenylmagnesiumchloride, methylmagnesium, ethylmagnesium, propylmagnesium, isopropylmagnesium, butylmagnesium, isobutylmagnesium., tert-butylmagnesium, sec-butylmagnesium, phenylmagnesium, magnesium acetate, magnesium hydrogenphosphate, cyclopentylmagnesium, cyclopentylmagnesiumhydroxide, cyclopentylmethylmagnesium, methylcyclopentylmethylmagnesium, allylmagnesium, benzylmagnesium, pentylmagnesium, 1,1-

dimethylpropylmagnesiumhydroxide, 1,1-dimethylpropylmethylmagnesium, phenylmagnesium, phenolmagnesi/urn, magnesium hydroxide, magnesiumcarbonate, magnesiumsilicide, magnesium phosphate, magnesium phosphite, magnesium bisulfite, L-aspartic acid magnesium, DL-aspartic acid magnesium, including analogue, homologue, isomer, and derivative thereof. Corresponding beryllium, calcium, strontium, barium, radium and zinc compounds are contemplated in the practice of this invention. See The Organic Compounds of Magnesium, Beryllium, Calcium, Strontium, and Barium, Ioffe, Nesmeyanov, Amsterdam (1967), Organomagnesium Methods in Organic Synthesis, Wakefield, Academic Press, FL (1995), incorporated by reference. The mixture of dialkyl magnesium compounds with pyrophoric metallics is specifically contemplated.

Non-limiting selenium, derivative compounds include: alkyl and dialkyl selenium compounds, dimethylselenium, dimethyl selenide, diethylselenium, dipropylselenium, diaisopropylselenium, diabutylselenium, diaisobutylselenium, dia-tert-butylselenium, dia-sec-butylselenium, di-phenylselenium, tetramethylselenium, tetraethylselenium, tetrapropylselenium, tetraisopropylselenium,

tetrabutyl-selenium, tetraisobutylselenium, tetra-tert-butylselenium, tetra-sec-butylselenium, tetra-phenylselenium, phenylselenium, methylphenylselenium, methylphenylselenide, methylphenolselenium, zinc selenite, di-n-butylphosphane selenide, selenanthrene, selenourea, selenophene, allylphenylselenide, 1,3-dihydro-benzoimid ________,2,3-dihydro-3-methyl , 1,1-dimethyl-2-selenourea, diphenyl diselenide, phenylselenyl chloride, benzeneseleninic acid, sodium selenite, benzeneseninic anhydride, potassium selenocyanate, selenourea, sodium hydrogenselenite, 4-chlorobenzeneseleninide, 4-(methylseleno)butyrate, benzyl selenide, alkyl selenium, including dimethylselenide, diethylselenide, dipropylselenide, etc., ally phenyl selenide, benzeneselenol, benzyl selenide, (phenylselenomethyl)trimethylsilane, potassium selenate, potassium selenite, selenic acid, dibenzyl diselenide, p-tolyl selenide, triphenylphosphine selenium, seleno-DL-methionine, P-tolyl selenide, including analogue, homologue, isomer, and derivative thereof. See Organoselenium Chemistry, Liotta, John Wiley & Sons, N.Y. (1987), incorporated herein by reference.

Non-limiting telluride derivative compounds include: di-n-butylphosphane selenide, selenanthrene, selenourea,

selenophene, allylphenylselenide, dimethyltelluride, diethyltelluride, dipropyltelluride, diisopropyltelluride, dibutyltelluride, diaisobutyltelluride, dia-tert-butyltelluride, dia-sec-butyltelluride, di-phenyltelluride, tetramethyltelluride, tetraethyltelluride, tetrapropyltelluride, tetraisopropyltelluride, tetrabuty-Itelluride, tetraisobutyltelluride, tetra-tert-butyltelluride, tetra-sec-butyltelluride, tetra-phenyltelluride, phenyltelluride, methylphenyltelluride, methylphenoltelluride, zinc selenite, di-n-butylphosphane telluride, diphenyl ditelluride, dimethyltelluride, diethyltelluride, dipropyltelluride, diisopropyltelluride, dibutyltelluride, diisobutyltelluride, di-tert-butyltel-luride, di-sec-butyltelluride, di-phenyltelluride, dimethylditelluride, diethylditelluride, dipropylditelluride, diisopropylditelluride, dibutylditelluride, diisobutylditelluride, di-tert-butylditelluride, di-sec-butylditelluride, di-phenylditel-luride, including analogue, homologue, isomer, and derivative thereof.

Non-limiting iron derivative compounds include:

[cyclopentadienyl] methylcyclopentadienyl iron, ferrocene, methylferrocene, and butadiene iron tricarbonyl, [butadiene iron tricarbonyl,] dicyclopentadienyl iron and dicyclopentadienyl iron compounds;ferrocene, methylferrocenes, decamethylferrocene bis(pentamethylcyclopentadienyl)iron), 1,1'-

diacetylferrocene, ferrocenecarboxylic acid,

1,1'-ferrocene-carboxylic acid, ferroceneacetic acid,

fer-roceneacetronitrile,

1,1'-ferrocenebis(diphenylphosphine),

ferrocenecarbonxaldehyde, f errocenecarboxylic acid-1,1'ferrocenedicarboxylic acid, 1,1'ferrocenedimethanol, ferrocenedimethanol, diiron nonacarbonyl, di-irondodecacarbonyl, di-ironnonacarbonyl, ironpentacarbonyl, triiron dodecacarbonyl, vinylferrocene, biscyclopentadienyl iron (ferrocene), cyclopentadienyl methylcyclopentadienyl iron, bis(methylcyclopentadienyl)iron, cyclopentadienyl ethylcyclopentadienyl iron, bis(ethylcyclopentadienyl)iron, bis(dimethylcyclopentadienyl)iron,bis(trimethyl-cyclopentad ienyl)iron, cyclopentadienyl tert-butyl-cyclopentadienyl iron, bis(pentamethylcyclopentadienyl)iron,

methylcyclopentadienyl ethylcyclopentadienyl iron, bis(hexylcyclopentadienyl)iron, bisindenyl iron, butadiene iron tricarbonyl, dicyclopentadienyl iron, cyclopentadienyl iron (di carbonyl) (iodide), cyclopentadienyl iron (carbonyl) (iodide) (methyltetrahydrofuran), iron (III) ferrocyanide, ammonium hexacyanoferrate (II) hydrate, cyclopentadienyliron dicarbonyl dimer, cyclopentadienyliron dicarbonyl iodide, iron pentacarbonyl, diiron nonacarbonyl, ferroceneacetic acid, ferroceneacetonitrile, ferrocenemethanol, acetylferrocene, including analogue, homologue, isomer, and derivative thereof. Other examples are set forth U.S. Patents 2,680,; 2,804,468; 3,341,311, The Organic Chemistry of Iron, Koerner, New York, Academic Press (1978), incorporated herein by reference.

Non-limiting nickel derivative compounds include: alkyl; aryl, alkyloxy, alkylanol, aryloxy, di/trialkyl, di/triaryl, di/trialkyloxy, di/trialkylanol, di/triaryloxy, and/or cyclomatic complexes, including, biscyclopentadienyl nickel, cyclopentadienyl methylcyclopentadienyl nickel, bis(methylcyclopentadienyl) nickel, bis(triphenylphosphine)-dicarbonyl nickel, bis(isopropylcyclppentadienyl) nickel, bisindenyl nickel, cyclopentadienyl nickel nitrosyl, methylcyclopentadienyl

nickel nitrosyl, including analogue, homologue, isomer, and derivative thereof.

Non-limiting cobalt derivative compounds include: bis-cyclopentadienyl cobalt, bis(methylcyclopentadienyl) cobalt, bis(dimethylcyclopentadienyl) cobalt, cyclopentadienyl cobalt, dicarbonyl, cobalt(ous) hexamethylenetetramine, cobalt(ous) hydroxyquinone, cyclopentadienylcobalt dicarbonyl, including analogue, homologue, isomer, and derivative thereof.

Non-limiting zinc derivative compounds include: alkyl zinc, aryl zinc, alkyloxy zinc, aryloxy zinc, dialkyl zinc, diaryl zinc, dialkyloxy zinc, diaryloxy zinc, cyclomatic zinc complexes, including, dimethylzinc, diethylzinc, dipropylzinc, diisopropylzinc, dibutylzinc, diisobutylzinc, di-tert-butylzinc, di-sec-butylzinc, di-phenylzinc, zinc acetate, zinc ethoxide, zinc arsenide, zinc hydroxide, zinc selenide, zinc selenite, zinc flouride, zinc chloride, zinc cyanide, zinc floride, zinc chloride, zinc undecylenate, zinc nitrate, zinc acrylate, zinc methacrylate, methyl zinc chloride, isobutylzinc chloride, zinc stearate, zinc dimethyldiethiocarbamate, di-n-propylzinc, di-o-tolyzinc, isobutylzinc chloride, methylzinc chloride, zinc methacrlate, zinc acrylate, zinc hexaflourosilicate, zinc nitrate, zinc

hydroxide, zinc undecylenate, zinc selenite, zinc cyanide, isobutylzinc chloride, methyl zinc chloride, L(+)lactic acid hemizinc, including analogues, homologues, isomers and derivatives thereof. Corresponding magnesium compounds are contemplated. See Zinc, The Science and Technology of the Metal, Its Alloys & Compounds, Mattewson, N.Y., Reinhold (1959), incorporated by reference.

Non-limiting examples of transition metal derivative compounds, e.g. metals of scandium, titanium, vanadium, chromium, manganese, iron, cobalt, nickel, and their respective chemical groups, include transition metal alkyl, aryl, alkyloxy, aryloxy, and/or ring system type compounds. Multiple alkyl, alkyloxy radicals per metal are contemplate. Cyclomatic transition metal compounds are expressly contemplated. See Organometallic Chemistry of Transition Metals, 2 Ed,,Crabtree, John Wiley & Sons, N.Y. (1994), incorporated herein by reference.

Non-limiting examples of manganese compounds include benzyleyelopentadienyl manganese tricarbonyl; 1.2-dipropyl 3-cyclohexylcyclopentadienyl manganese tricarbonyl; 1.2-diphenylcyclopentadienyl manganese tricarbonyl; 3-propenylienyl manganese tricarbonyl; 2-tolyindenyl

manganese tricarbonyl; fluorenyl manganese tricarbonyl; 2.3.4.7 -propyflourentyl manganese tricarbonyl; 3-naphthylfluorenyl manganese tricarbonyl; 4.5.6.7-tetrahydroindenyl manganese tricarbonyl; 3-3ethenyl-4, 7-dihydroindenyl manganese tricarbonyl; 2-ethyl 3 (a-phenylethenyl) 4,5,6,7 tetrahydroindenyl manganese tricarbonyl; 3 - (a-cyclo-hexylenthenyl) -4.7 - dihydroindenyl manganese tricarbonyl; 1,2,3,4,5,6,7,8 - octahydrofluorenyl manganese tricarbonyl and the like. A preferred cyclomatic manganese tricarbonyl is cyclopentadienyl manganese tricarbonyl. A more preferred cyclomatic manganese tricarbonyl is methyl cyclopentadienyl manganese (MMT).

Non-limiting examples of acceptable substitutes include the alkyl, aralkyl, aralkenyl, cycloalkyl, cycloalkenyl, aryl and alkenyl groups. The above compounds can be generally prepared by methods that are known in the art. Corresponding compounds of technetium and rhenium.(see Canadian Patent #1073207) are contemplated.

Non-limiting nitrogen derivative compounds include: 2-methoxybenzylamine, 2-methoxybenzylamine, 2-(4-methoxyben-zylamino)pyridine, nitroanline, 1-nitroanline, 2-nitroanline, 3-nitroanline, 4-nitroanline,

nitroanisole, 1-nitroanisole, 2-nitroanisole, 3-nitroanisole, 4-nitroanisole, aniline, 2-anilinoethanol, anisamide, anisonitrile, acetonitrile, nitromethane, nitroethane, picoline, 1-picoline, 2-picoline, 3-picoline, 4-picoline, tetramethylammoniumhydroxide, dimethylolurea, 1,1-dibutylurea, tetraethylammoniumhydroxide, N,N,N',N'-tetra-methylethylenediamine, toluic hydazide, toluidine, m-tol-uidine, o-toluidine, p-toluidine, tolunitrile, o-tolunitrile, p-tolunitrile, triazacyclononane, triazole, 1,2,4-triazole, triazine, 1,3,5-triazine, tributylamine, triethanolamine, trimethanolamine, tripropanolamine, trimethoxypyrimidine, 2,4,6-trimethoxypyrimidine, tetramethylammonium, trimethylpyrazine, urea, urazole, guanidine nitrate, guandine acetatic acid, thiophenol, sodium salt thiophenol, thiourea, cumidine, diphenylamine, m-xylidine, monmelthylanine, toluidine, amylaminobenzene, ethylaminobenzene, aminophenyl, methyl-o-toluidine, n-butylaminobenzene, n-propylaminobenzene, monoethylaniline, mon-n-propylaniline, ethyldiphenylamine, mono-n-butylaniline, diethylamine, di-n-propylaniline, mono-isoamylaniline, diethylaniline, dimethylaniline, ethylamine, triethylamine, triphenylamine,

isopropylnitrite, ammonia, including analogues, homologues, isomers and derivatives thereof.

Other non-limiting nitrogen compounds include monethylanile, ethylenediamine, isoethyl nitrate, methylamine, monoethylaniline, nitroglycerine, n-propyl nitrate, o-toluidine, triethylamine, trimethylamine, hydrazines, dimethyl hydrazine, monomethylhydrazine, methylhydrazine, symmetrical dimethylhydrazine, unsymmetrical dimethylhydrazine, tetranitromethane, hydrozide xylidine, 2,3-xylidine, ammonium nitrate, potassium nitrate, nitric acid, ammonium azide, ammonium perchlorate, nitrogen trioxide, nitrogen dioxide, hydrazoic acid, dicyanogen, hydrocyanic acid, amines, anilines, amides, hydrazines, nitrosyls, imides, nitrates, dinitrate compounds alkyl nitrates, nitromethane, nitroethane, nitropropane, di-nitrates, amines, anilines, amides, hydrazines, nitrosyls, imides, nitro-ethers, anilines, nitro-ethers, amines, methylamines, amides, nitrosyls, imides, monethylanile, aniline, ethylenediamine, isoethyl nitrate, methylamine, monoethylaniline, nitroglycerine, n-propyl nitrate, o-toluidine, triethylamine, trimethylamine, hydrazines, dimethyl hydrazine, monomethylhydrazine, methylhydrazine, symmetrical dimethylhydrazine, unsymmetrical

dimethylhydrazine, xylidine, 2,3-xylidine, ammonia, ammonium nitrate, potassium nitrate, nitric acid, ammonium azide, ammonium perchlorate, nitrogen trioxide, nitrogen dioxide, hydrazoic acid, dicyanogen, hydrocyanic acid, alkyl nitrate, optionally selected from the group consisting of methyl nitrate, ethyl nitrate, isoethyl nitrate, n-propyl nitrate, iso-propyl nitrate, ethyl-hexyl nitrate nitrates, alkyl nitrates, nitromethane, nitroethane, nitropropane, di-nitrates, amines, anilines, amides, hydrazines, nitrosyls, imides, nitro-ethers, anilines, nitro-ethers, amines, methylamines, amides, nitrosyls, imides, monethylanile, aniline, ethylenediamine, isoethyl nitrate, methylamine, monoethylaniline, nitroglycerine, n-propyl nitrate, o-toluidine, triethylamine, trimethylamine, hydrazines, dimethyl hydrazine, monomethylhydrazine, methylhydrazine, symmetrical dimethylhydrazine, unsymmetrical dimethylhydrazine, xylidine, 2,3-xylidine, ammonia, ammonium nitrate, potassium nitrate, nitric acid, (ammonium azide, ammonium perchlorate, nitrogen trioxide, nitrogen dioxide, hydrazoic acid, dicyanogen,- hydrocyanic acid, tetranitrpmethane, nitromethane, nitroethane, or nitropropane and mixture. Aryl, cycloalkyl, and aryl nitrates including organo nitrates, such as nitrobenzenes,

dinitrobenzenes, nitrotoluenes/; dinitrotoluenes, 2-ethylhexylnitrate, derivates, homologues and analogues are comtemplated herein.

Non-limiting titanium derivative compounds include: titanium diisopropoxide bis(2,4-pentanedionate), titanium methoxide, titanium ethoxide, titanium (IV) 2-ethylexoxide, titanium isopropoxide, tetraethylorthotitanate, including analogues, homologues, isomers and derivatives thereof.

Non-limiting zirconium derivative compounds include: zirconium carbide, zirconium propoxide, zirconium ethoxide, decamethylzirconocene, decamethylzirconocene dichloride, bis-cyclopentadieriyl zirconium, including analogues, homologues, isomers and derivatives thereof.

Non-limiting molybdenum derivative compounds include: molybdenumcarbonyl, molybdenum hexacarbonyl, tripyridine . tricarbonylmolybdenum, molybdenumoxytetrachloride/ cyclopentadienyl molybdenum carbonyls, including but not limited to benzenemolybdenumtricarbonyl, bicycloheptadienemolybdenum tetracarbonyl, cycloheptatrien-molybdenum tricarbonyl,

bis-cyclopentadienylbimolybdenum pentacarbonyl, mesitylenemolybdenum tricarbonyl, tropeniummolybdenum tricarbonyl fluoroborate, cyclopentadienylmolybdenum tricarbonyl dimer, methylcyclopentadienylmolybdenum tricarbonyl dimer, anisole molybdenum tricarbonyl, mesitylene molybdenum tricarbonyl, including analogue, homologue, isomers and derivative thereof. See U.S. Patents 3,272,606, and 3,718,444, incorporated by reference. Corresponding chromium and tungsten compounds are contemplated in the practice of this invention.

Non-limiting copper derivative compounds include: alkyl copper compounds, bis(ethylenediamine)copper(II) hydroxide, copper carbonate, cyclopentadienyltriethylphosphine copper., diazoaminobenzene (ous), copper acetate, copper acetylacetonate, copper aminoacetate, copper ethylacetate, copper ferrocyanide, copper potassium ferrocyanide, copper nathenate, copper nitrate, copper phosphide, copper phthalate, including analogue, homologue, isomers and derivative thereof. See Copper, The Science and Technology of the Metal, Its Alloys & Compounds, Butts, N.Y., Reinhold (1954), incorporated by reference.

Other contemplated organometallic compounds are

metal-locenes, non-limiting example compounds include, ferrocene, cobaltocene, nic'kelocene, titanocene diahloride, zirconocene dichloride, uranocene, decamethylferrocene, decamethylsilicocene, decamethylgermaniumocene, decamethylstannocene, decamethylphosocene, decamethylosrhocene, decamethylruthenocene, decamethyl-zirconocene, including analogue, homologue, isomers and derivative thereof.

It is to be noted the above list is not exhaustive. The metals and their derivative compounds of this invention include every metal, metalloid, and/or non-metal (herein "metal" or "metallic") capable of acheiving vapor phase combustion, individually or incombination with Applicant's said ECS oxygenates.

Applicant's invention contemplates wide variation in metal substitution and mixing practice. Thus, it is expressly contemplated the non-lead organo-tnetallies, non-lead inorganic metallics, and/or their related high heat releasing compounds, including those set forth above may be mixed in varying proportions, and/or substituted and/or replaced by any non-lead metallic or non-metallic (organic or inorganic [atom, molecule or compound, including those containing nitrogen,

sulfur, chlorine, fluorine, helium, neon, argon, krpton, xenon, or radon atoms]) accomplishing the object of this invention.

Metal derivative compounds and combinations may be entirely or may contain in part or'whole non-metal atoms, e.g. nitrogen, sulfur, chlorine, fluorine, helium, neon, argon, krpton, xenon, or radon, etc., so long as primary object of vapor phase combustion is, accomplished. It is contemplated Applicant's metals are substitutents in the fuel, itself, which may also contain certain non-metals, and their derivative compounds, including but not limited to nitrogen, sulfur, fluorine, chlorine, helium, neon, argon, krpton, xenon, or radon, in combination with dialkyl carbonates. These non-metals, and their derivative compound, may be employed with or without any other contemplated metals. It is further contemplated to substitute or mix these non-tnetallics with non-metallics, with metallics, or to mix metallics with metallics, etc., to achieve synergistic improvements in heat releases, burning velocity, thermal efficiency, emission reductions, power generation, and the like.

It is contemplated said non-metals will employed invarying proportions within the compound or combination compounds to achieve synergistic improvements in heat releases, burning

velocity, thermal efficiency, emissions, power generation, and the like. For example, hexamethylphosphoric triamide, N,N,N',N'- hexamethylsilanediamine, bis(diethylamono)-dimethylsilane may be added as a co-metallic or as a secondary co-combustion agent to the co-combustion agents set forth above. Concentrations will be minor, but sufficient to further improve vapor phase combustion (e.g further enhancing fuel ecomony or power, etc.).

Ranges vary depending upon the specific metallic, fuels, fuel weight, regulations, advance applications, thermodynamics, and the extent combustion systems are modified to enhance the accelerated low temperature high energy nature of Applicant's invention. Thus, metallic concentrations that maximize combustion velocity and/or the vapor phase combustion object of this invention are expressly contemplated.

However, it is contemplated that Applicant's fuel also be absent any metal or non-metal. That is, Applicant's invention, by accelerating burning velocity and/or increasing latent heat of vaporization, and/or reducing combustion temperatures by fuel substituent tailoring, chemical and/or mechanical means, as set forth herein or in the afforementioned PCT Applications, said fuel can be employed absent either an ECS oxygenate or a

metallic or non-metallic.

In accordance with this invention, Applicant's fuels will contain that amount of at least non-lead metallic, which constitutes a combustion improving amount consistent with the fuel composition, stoichiometry, combustion system, efficiencies, fuel economy and power desired, as well as legal and/or environmental considerations.

It is expressly contemplated that Applicant's metallics be incorporated into liquid fuel systems by means of mutual solvents, mutual dispersents/solvents, colloidal media, suspension media, or other known means, or being separately injected. Metallic's, which are solid at ambiant temperatures may be introduced into the combustor/combustion chamber by liquidification or gasification means.

It is preferred the metallics of this invention be relatively inexpensive to manufacture on a mass production basis.

The metal, metalloid, NLEC and combustion catalysts concentration amounts are to be optimized, such that vapor phase combustion results. Thus, the metal and its optimum concentration amount, is an amount that results in vapor phase combustion, which is evidenced by improved thermal efficiency,

fuel economy emissions, power, etc. In the practice of this invention, the ratio of oxygenated ECS. compound by weight to elemental metal, metalloid, NLEC and combustion catalystby weight in the composition' is equal to or less than 10,000:1 (parts) to equal or greater than 1:1. Other ratios include from 1,000,000:1 to 100,000:1; 100,000:1' to.50,000:1; 50,000:1 to 25,000:1; 25,000:1 to 15,000:1; ,15,000:1 to 12,000:1, 12,000:1 to 11,000:1,, 11,000:1 to 1/0,000:1, 9,000:1, 8,000:1, 7,000:1, 6,000;1, 5,000:1, 4,000:1, 1,000:1, 900:1, 500:1, 300:1, 200:1, 150:1, 100:1, 90:1, 80:1, 75:1, 70:1, 60:1, 50:1, 40:1, 30:1, 20:1, 10:1, 5:1 to 3:1, or interval ratio contained therein (e.g. 50:1 to 3-0:1) and also 1:1 to 1:20, or any other ratio that maximizes vapor phase combustion. Other acceptable concentrations in a fuel composition for said ingredients (individually or in combination) include from 1 to 3000 ppm, 1 to 2000 ppm 1 to 1000 ppm, 1 to 500 ppm, 1 to 400 ppm, 1 to 250 ppm, '1 to 100 ppm, 1 to 50 ppm, 1 to 10 ppm or any other concentrations which maximizes combustion, and is contempated in the claims below.

Metallic salts may be employed in fuels at 0.01 to 4000.0 parts metallic per million fuel, 1.0 to 150 ppm metallic being contemplated, with concentrations equal or less than 50.0, 40.0,

30.0, 20.0, 16.0, 10.0, 5.0 ppm metallic also contemplated. Other salt concentrations will vary from 0.10 to 75.0 ppm metal per million, from 30.0 to 2000.0 per million, from 25 to 750 parts metallic or salt per million fuel. In the application of Applicant's invention elemental metal concentrations from 3.0 to 500.0 ppm metal are expressly contemplated and desirable. Concentrations outside these ranges are contemplated.

It has been found that higher oxygen weight concentrations in fuel compositions, particularly with higher concentrations of enhanced combustion properties, permit higher acceptable metallic concentrations. Higher average fuel densities are also associated with higher acceptable metallic concentrations and higher exhaust velocities, and are preferred. Engine combustion thermal dynamics and stoichiometry dictate upper metallic limits.

As noted above, elemental metallic concentrations will vary substantially. Non-limiting examples include elemental metallic concentrations equal to or greater than 1/64, 1/32, 1/16, 3/32, 1/8, 5/32, 3/16, 1/4, 5/16, 3/8, 7/16, 1/2, 5/8, 3/4, 7/8, 1, 1.25, 1.5, 1.75, 2.0, 2.25, 2.5, 2.75, 3.0, 3.25, 3.5, 3.75, 4.0, 4.5, 5.0, 5.5, 6.0, 6.5, 7.0, 7.5, 8.0, 8.5, 9.0, 9.5, 10.0 grams/gal. In advance aviation, rocket and/or

propellant and other applications, elemental metal concentrations can be on the order of 10 to 25, 20 to 40, 20. to 50, 20 to 100, even 50 to 1000, or more, grams/gal, especially in hypergolic conditions. Concentrations both above and below these ranges are contemplated. All combustion improving or stoichiometric amounts of elemental metal are contemplated, which maximize combustion so long as the resultant fuel's burning velocity increases compared to fuel absent metallic.

Thus, those metallic concentrations that maximize combustion velocity and/or other objects of this invention are expressly contemplated. Ranges will vary depending upon the specific metallic, its concentration, concentration and type of ECS oxygenates, the concentration and nature of hydrocarbon fuel composition, including its density, the intended application, relevant thermodynamics, extent combustion systems are modified to enhance the accelerated low temperature high energy nature of Applicant's invention, environmental regulation, and the like.

Metallics used in the fuel compositions of the present invention should be fuel soluble, generally having melting and boiling ranges compatible with liquid hydrocarbons, or be incorporated into liquid fuel systems by means of mutual

solvents, dispersants, or other means, as required. Alternatively, the metallics may be introduced into the combustor/combustion chamber of liquide or gaseous fuels (e.g. natural gas) by separate means, including separate injection, liquidification or gasification, colloidal media, suspension media. Metallics may be introduced into the combustor in an atomized, vaporized, or gasified form, separately and/or in combination with the other ingredients of the invention.

In solid fuel applications, the metallic may be introduced as a solid. In hybrid applications, it may be introduced as either as solid, liquid or gas, together with the balance of the invention's ingredients. Most preferably, the metallic is employed as a propellant or co-propellant, or jointly together with a propellant. Hydrogen content of the metallic and/or metallic containing fuel should be maximized, to the extent possible.

Those skilled in the art will appreciate that many variations and modifications of the invention disclosed herein may be made without departing from the spirit and scope thereof.

EXAMPLES BELOW INCLUDE BY INCORPORATION THE COMBUSTION CATALYSTS SET FORTH HEREIN

1. A fuel composition comprising:

i. a non-leaded element, or an organic or inorganic compound containing said element, being selected from the group of elements of groups 1A, 2A, 3A, IB, 2B, 3B, 4B, 5B, 6B, 7B, 8, and from iodine, bismuth, germanium, phosphorus, silicon, nitrogen, sulfur, fluorine,, chlorine and tin and mixture thereof, said element or its organic or inorganic compound being present in combustible form (Non-Lead Element Compound "NLEC"); and;

ii. a dialkyl carbonic acid ester (dialkyl carbonate) iii. a COMBUSTION CATALYST;

2. A fuel composition comprising:

i. at least one non-leaded element, or an organic or inorganic compound containing said element, said element being selected from the group of elements Li, Be, B, F, N, Na, Mg, Al, Si, P, S, Cl, K, Ca, Sc, Ti, V, Cr, Mn, Fe, Co, Ni, Cu, Zn, Ga, Ge, Br, Rb, Sr, Y, Z.r, Nb, Mo, Tc, Ru, Rh, Pd, Ag, Cd, In, Sn, I, or Cs and mixture thereof, wherein said element or its organic or inorganic compound being present in combustible form (Non-Lead Element Compound "NLEC"); and

ii. a compound selected from a glycol, or a glycol ether,

optionally containing at least one substituent selected from alkyl, alkyloxy, dialkyl, diethylene, dialkyloxy, methylene, ethylene, polyalkyl, polyalkyloxy, aryl, amide, acetate, aldehyde, carboethoxy, carbomethoxy, carbonyl, carbonyldioxy, carboxy, ethoxalyl, ethoxy, formyl, glycolyl, glyoxylyl, hydroxyl, imide, methoxy, methylenedioxy or nitrosyl radical, and mixtures thereof; iii. a COMBUSTION CATALYST

3 . An improved fuel economy composition for spark-ignited internal combustion engine, comprising:

i. a nonleaded gasoline base comprised of hydrocarbons, ii. a cyclopentadienyl manganese tricarbonyl antiknock compound having a manganese concentration greater than 0.008256 gr/liter Mn and less than 0.2642 gr/liter Mn in the fuel composition; iii. a combustion burning velocity increasing and/or combustion temperature reducing amount an oxygenate additive selected from the group consisting of carbon monoxide, methylene dimethyl ether, carbonic acid dimethyl ester, carbonic acid diethyl ester, dimethyl ether, diisopropyl ether, methyl tertiary butyl ether, ethyl tertiary butyl ether, ethyl tertiary amyl ether, methanol, ethanol, isopropanol, n-butanol, isobutanol, 2-butanol, tertiary butanol, and mixture thereof;

iv. a COMBUSTION CATALYST

4 . A hydrocarbon aviation or automobile gasoline composition characterized as having a minimum laminar flame burning velocity of 46 cm/sec (compared to methanol 57.2 cm/sec) comprising:

i. a hydrocarbon base boiling in aviation or automobile gasoline ranges;

ii. at least one non-leaded element, or an organic or inorganic compound containing said element, said element being selected from the group of elements of groups 1A, 2A, 3A, IB, 2B, 3B, 4B, 5B, 6B, 7B, 8, and from iodine, bismuth, germanium, phosphorus, silicon, nitrogen, sulfur, fluorine, chlorine and tin and mixture thereof, said element or its organic or inorganic compound being present in combustible form (Non-Lead Element Compound "NLEC"); and iii. at least one Enhanced Combustion Structure ("ECS) compound reducing combustion temperature and/or increasing burning velocity, said compound having a latent heat of vaporization (LHV) equal to or greater 21 kJ mol^{-1} at its boiling temperature, and a minimum burning velocity (as measured by laminar Bunsen flame) of 40 cm/sec ("BV"), selected from the group consisting of acetic acid, acetates, acetyls, alcohols, aldehydic acids, aldehydes,

anhydrides, boric acids, carbonic esters, carboxylic acids; carbonates, di-carbonates, esters, di-esters, ethers, di-ethers, formic acids, glycols, glycol. ethers, hydroxyacids, ketones, ketonic acids, nitrates, alkyl nitrates, nitromethane, nitroethane, nitropropane, di-nitrates, amines, anilines, amides, hydrazines, nitrosyls, imides, nitro-ethers, anilines, nitro-ethers, amines, methylamines, imides, xylidine, 2,3-xylidine, ammonia, orthoborates, othroesters, orthoacids, oxides, oxalates, oxalic acids, peroxides, hydroperoxides, and phenols, said compound optionally containing at least one substituent'selected from alkyl, alkyloxy, dialkyl, dialkyloxy, polyalkyl, polyalkyloxy, aryl, amide, acetate, aldehyde, carboethoxy, carbomethoxy, carbonyl, carbonyldioxy, carboxy, ethoxalyl, ethoxy, formyl, glycolyl, glyoxylyl, hydroxyl, imide, methoxy, or methylenedioxy radical, and mixtures thereof, (under the proviso any mixture has an average LHV of at least 21 kJ mol^{-1} and a BV of at least 40 cm/sec);

iv. a COMBUSTION CATALYST

5. An unleaded hydrocarbon gasoline composition having a minimum latent heat of vaporization ("LHV") of 860 BTU/gallon @ 60°F comprising:

i. a hydrocarbon base boiling in aviation or automobile

gasoline ranges

ii. at least one non-leaded element, or an organic or inorganic compound containing said element, said element being selected from the group of elements of groups 1A, 2A, 3A, IB, 2B, 3B, 4B, 5B., 6B, 7B, 8, and from iodine, bismuth, germanium, phosphorus, silicon, nitrogen, sulfur, fluorine, chlorine and tin and mixture thereof, said element or its organic or inorganic compound being present in combustible form (Non-Lead Element Compound "NLEC"); and iii. At least one Enhanced Combustion Structure ("ECS) compound reducing combustion temperature and/or increasing, burning velodity, said compound having a minimum burning velocity (as measured by laminar Bunsen flame) of 40 cm/sec ("BV"), selected from the group consisting of acetic acid, acetates, acetyls, alcohols, aldehydic acids, aldehydes, anhydrides, boric acids, carbonic esters, carboxylic acids, carbonates, di-carbonates, esters, di-esters, ethers, di-ethers, formic acids, glycols, glycol ethers, hydroxyacids, ketones, ketonic acids, nitrates, alkyl nitrates, nitromethane, nitroethane, nitropropane, di-nitrates, amines, anilines, amides, hydrazines, nitrosyls, imides, nitro-ethers, anilines, nitro-ethers, amines, methylamines, imides, xylidine, 2,3-xylidine, ammonia,

orthoborates, othroesters, orthoacids, oxides, oxalates, oxalic acids, peroxides, hydroperoxides, and phenols, said compound optionally containing at least one substituent selected from alkyl, alkyloxy, dialkyl, dialkyloxy, polyalkyl, polyalkyloxy, aryl, amide, acetate, aldehyde, carboethoxy, carbomethoxy, carbonyl, carbonyldioxy, carboxy, ethoxalyl, ethoxy, formyl, glycolyl, glyoxylyl, hydroxyl, imide, methoxy, or methylenedioxy radical, and mixtures thereof.

iv. a COMBUSTION CATALYST

An automotive gasoline having a maximum T-90 distillation fraction boiling at 174°C (345°F) or an aviation gasoline having a maximum end boiling point of 165°C (328°F) , comprising:

v. An unleaded hydrocarbon base,

vi. at least one non-leaded element, or an organic or inorganic compound containing said element, said element being selected from the group of elements of groups 1A, 2A, 3A, IB, 2B, 3B, 4B, 5B, 6B, 7B, 8, and from iodine, bismuth, germanium, phosphorus, silicon, nitrogen, sulfur, fluorine, chlorine and tin and mixture thereof, said element or its organic or inorganic compound being present in combustible form (Non-Lead

Element Compound "NLEC"); and vii. at least one Enhanced Combustion Structure ("ECS) compound reducing combustion temperature and/or increasing burning velocity, said compound having a latent heat of vaporization (LHV) equal to or greater 21 kJ mol^{-1} at its boiling temperature, and a minimum burning velocity (as measured by laminar Bunsen flame) of 40 cm/sec ("BV"), selected from the group consisting of acetic acid, acetates, acetyls, alcohols, aldehydic acids, aldehydes, anhydrides, boric acids, carbonic esters, carboxylic acids, carbonates, di-carbonates, esters, di-esters, ethers, di-ethers, formic acids, glycols, glycol ethers, hydroxyacids, ketones, ketonic acids, nitrates, alkyl nitrates, nitromethane, nitroethane, nitropropane, di-nitrates, amines, anilines, amides, hydrazines, nitrosyls, imides, nitro-ethers, anilines, nitro-ethers, amines, methylamines, imides, xylidine, 2,3-xylidine, ammonia, orthoborates, othroesters, orthoacids, oxides, oxalates, oxalic acids, peroxides, hydroperoxides, and phenols, said compound optionally containing at least one substituent selected from alkyl, alkyloxy, dialkyl, dialkyloxy, polyalkyl, polyalkyloxy, aryl, amide, acetate, aldehyde, carboethoxy, carbomethoxy, carbonyl, carbonyldioxy, carboxy, ethoxalyl, ethoxy, formyl, glycolyl, glyoxylyl, hydroxyl,

imide, methoxy, or methylenedioxy radical, and mixtures thereof,
viii. a COMBUSTION CATALYST

6 . An unleaded hydrocarbon fuel composition comprising:

i . a hydrocarbon base,

ii. at least one non-leaded element, or an organic or inorganic compound containing said element, said element being selected from the group of elements of groups 1A, 2A, 3A, IB, 2B, 3B, 4B, 5B, 6B, 7B, 8, and from iodine, bismuth, germanium, phosphorus, silicon, nitrogen, sulfur, fluorine, chlorine and tin and mixture thereof, said element or its organic or inorganic compound being present in combustible form (Non-Lead Element Compound "NLEC"); and iii. at least one Enhanced Combustion Structure ("ECS) compound reducing combustion temperature and/or increasing burning velocity, said compound having a latent heat of vaporization (LHV) equal to or greater 21 kJ mol^{-1} at its boiling temperature, and a minimum burning velocity (as measured by laminar Bunsen flame) of 40 cm/sec ("BV"), selected from the group consisting of acetic acid, acetates, acetyls, alcohols, aldehydic acids, aldehydes, anhydrides, boric acids, carbonic esters, carboxylic acids, carbonates, di-carbonates, esters, di-esters, ethers,

di-ethers, formic acids, glycols, glycol ethers, hydroxyacids, ketones, ketonic acids, nitrates, alkyl nitrates, nitromethane, nitroethane, nitropropane, di-nitrates, amines, anilines, amides, hydrazines, nitrosyls, imides, nitro-ethers, anilines, nitro-ethers, amines, methylamines, imides, xylidine, 2,3-xylidine, ammonia, orthoborates, othroesters, orthoacids, oxides, oxalates, oxalic acids, peroxides, hydroperoxides, and phenols, said compound optionally containing at least one substituent selected from alkyl, alkyloxy, dialkyl, dialkyloxy, polyalkyl, polyalky],oxy, aryl, amide, acetate, aldehyde, carboethoxy, carbomethoxy, carbonyl, carbonyldioxy, carboxy, ethoxalyl, ethoxy, formyl, glycolyl, glyoxylyl, hydroxyl, imide, methoxy, or methylenetiioxy radical, and mixtures thereof, iv. a COMBUSTION CATALYST

v. wherein the constituents of the fuel composition and their respective amounts are tailored such that fuel compositions having the following maximum T-90 distillation fraction temperatures and maximum boiling point end temperatures respectively are obtained:

□# 1 diesel, # 1 gas turbine fuel oil, or #1 fuel oil with a maximum T-90 distillation fraction temperature of 288°C;

□#2 diesel, # 2 gas turbine fuel oil, or # 2 fuel oil with a maximum T-9,0' distillation fraction temperature of 338°C; or

□a a jet turbine fuel oil with a maximum end boiling point temperature of 300°C.

7. A Rocket fuel composition having a minimum specific impulse of not less than 200 I_{sp} Sec., comprising:

i. at least one non-leaded element, or an organic or inorganic compound containing said element, said element being selected from the group of elements of groups 1A, 2A, 3A, IB, 2B, 3B, 4B, 5B, 6B, 7B, 8 (CAS version), and from iodine, bismuth, germanium, phosphorus, silicon, nitrogen, sulfur, fluorine, chlorine and tin and mixture thereof, said element or its organic or inorganic, compound being present in combustible form (Non-Lead Element Compound "NLEC"), optionally having heats of combustion of 9000 Kcal/mol; and

ii. at least one Enhanced Combustion Structure ("ECS) compound reducing combustion temperature and/or increasing burning velocity, said compound having a latent heat of vaporization (LHV) equal to or greater 21 kJ mol^{-1} at its boiling temperature, and a minimum burning velocity (as measured by laminar Bunsen flame) of 40 cm/sec ("BV"), selected from the group consisting

of acetic acid, acetates, acetyls, alcohols, aldehydic acids, aldehydes, anhydrides, boric acids, carbonic esters, carboxylic acids, carbonates, di-carbonates, esters, di-esters, ethers, di-ethers, formic acids, glycols, glycol ethers, hydroxyacids, ketones, ketonic acids, nitrates, alkyl nitrates, nitromethane, nitroethane, nitropropane, di-nitrates, amines, anilines, amides, hydrazines, nitrosyls, imides, nitro-ethers, anilines, nitro-ethers, amines, methylamines, imides, xylidine, 2,3-xylidine, ammonia, orthoborates, othroesters, orthoacids, oxides, oxalates, oxalic acids, peroxides, hydroperoxides, and phenols, said compound optionally containing at least one substituent selected from alkyl, alkyloxy, dialkyl, dialkyloxy, polyalkyl, polyalkyloxy, aryl, amide, acetate, aldehyde, carboethoxy, carbomethoxy, carbonyl, carbonyldioxy, carboxy, ethoxalyl, ethoxy, formyl, glycolyl, glyoxylyl, hydroxyl, imide, methoxy, or methylenedioxy radical, and mixtures thereof,

iii. a COMBUSTION CATALYST

iv. optionally a propellant,

v. optionally an oxidizer,

8 . An unleaded hydrocarbon fuel composition comprising:

i. a hydrocarbon,

ii. at least one non-leaded element, or an organic or inorganic compound containing said element, said element being selected from the group of elements of groups 1A, 2A, 3A, IB, 2B, 3B, 4B, 5B, 6B, 7B, 8 (CAS version), and from iodine, bismuth, germanium, phosphorus, silicon, nitrogen, sulfur, fluorine, chlorine and tin and mixture thereof, said element or its organic or inorganic compound being present in combustible form (Non-Lead Element Compound "NLEC"); and iii. at least one Enhanced Combustion Structure ("ECS) compound reducing combustion temperature and/or increasing burning velocity, said compound having a latent heat of vaporization (LHV) equal to or greater 21 kJ mol^{-1} at its boiling temperature, and a minimum burning velocity (as measured by laminar Bunsen flame) of 40 cm/sec ("BV"), selected from the group consisting of acetic acid, acetates, acetyls, alcohols, aldehydic acids, aldehydes, anhydrides, boric acids, carbonic esters, carboxylic acids, carbonates, di-carbonates, esters, di-esters, ethers, di-ethers, formic acids, glycols, glycol ethers, hydroxyacids, ketones, ketonic acids, nitrates, alkyl nitrates, nitromethane, nitroethane, nitropropane, di-nitrates, amines, anilines, amides, hydrazines, nitrosyls, imides, nitro-ethers,

anilines, nitro-ethers, amines, methylamines, imides, xylidine, 2,3-xylidine, ammonia, orthoborates, othroesters, orthoacids, oxides, oxalates, oxalic acids, peroxides, hydroperoxides, and phenols, said compound optionally containing at least one substituent selected from alkyl, alkyloxy, dialkyl, dialkyloxy, polyalkyl, polyalkyloxy, aryl, amide, acetate, aldehyde, carboethoxy, carbomethoxy, carbonyl, carbonyldioxy, carboxy, ethoxalyl, ethoxy, formyl,

glycolyl, glyoxylyl, hydroxyl, imide, methoxy, or methylenedioxy radical, and mixtures thereof,

iv. a COMBUSTION CATALYST

9 . A method for improving combustion thermal efficiency of a fuel, comprising:

a. mixing a fuel comprised of:

i. at least one element other than lead or an organic or inorganic compound containing said element, said element being selected from the group of elements of groups 1A, 2A, 3A, IB, 2B, 3B, 4B, 5B, 6B, 7B, 8, and also selected from the group co, iodine, bismuth, germanium, phosphorus, silicon, nitrogen, sulfur, fluorine, chlorine and tin and mixtures thereof, said element or the derivative organic or inorganic compound being present in combustible form (Non-Lead Element Compound "NLEC");

and

ii. at least one Enhanced Combustion Structure ("ECS) compound reducing combustion temperature and/or increasing burning velocity, said compound having a latent heat of vaporization (LHV) equal to or greater 21 kJ mol^{-1} at its boiling temperature, and a minimum burning velocity (as measured by laminar Bunsen flame) of 40 cm/sec ("BV"), selected from the group consisting of acetic acid, acetates, acetyls, alcohols, aldehydic acids, aldehydes, anhydrides, boric acids, carbonic esters, carboxylic acids, carbonates, di-carbonates, esters, di-esters, ethers, di-ethers, formic acids, glycols, glycol ethers, hydroxyacids, ketones, ketonic acids, nitrates, alkyl nitrates, nitromethane, nitroethane, nitropropane, di-nitrates, amines, anilines, amides, hydrazines, nitrosyls, imides, nitro-ethers, anilines, nitro-ethers, amines, methylamines, imides, xylidine, 2,3-xylidine, ammonia, orthoborates, othroesters, orthoacids, oxides, oxalates, oxalic acids, peroxides, hydroperoxides, and phenols, said compound optionally containing at least one substituent selected from al-kyl, alkyloxy, dialkyl, dialkyloxy, polyalkyl, polyalkyloxy, aryl, amide, acetate, aldehyde, carboethoxy, carbomethoxy, carbonyl, carbonyldioxy, carboxy, ethoxalyl, ethoxy, formyl, glycolyl, glyoxylyl,

hydroxyl, imide, methoxy, or methylenedioxy radical, and mixtures thereof, under the proviso any mixture has an average LHV of at least 21 kJ mol^{-1} and a BV of at least 40 cm/sec.

iii. a COMBUSTION CATALYST

b. atomizing said fuel whereby resultant particles have an average size not exceeding 70 /im (microns) are formed;

c. introducing said atomized fuel into an engine or combustor; and

d. combusting said fuel. 10. Use of a combination of:

i. at least one non-leaded element or derivative organic or inorganic compound containing said non-lead element, selected from the group consisting of 1A, 2A, 3A, IB, 2B, 3B, 4B,' 5B, 6B, 7B, 8, and also selected from the group co, iodine, bismuth, germanium, phosphorus, silicon, nitrogen, sulfur, fluorine, chlorine and tin and their mixture,, wherein said /element or derivative compound is in combustible form (Non-Lead Element Compound "NLEC"); and

ii. at least one Enhanced Combustion Structure ("ECS) compound reducing combustion temperature and/or increasing burning velocity, said compound having a latent heat of vaporization (LHV) equal to or greater 21 kJ mol^{-1} at its boiling temperature,

and a minimum burning velocity (as measured by laminar Bunsen flame) of 40 cm/sec ("BV"), selected from the group consisting of acetic acid, acetates, acetyls, alcohols, aldehydic acids, aldehydes, anhydrides, boric acids, carbonic esters, carboxylic acids, carbonates, di-carbonates, esters, di-esters, ethers, di-ethers, formic acids, glycols, glycol ethers, hydroxyacids, ketones, ketonic acids, nitrates, alkyl nitrates, nitromethane, nitroethane, nitropropane, di-nitrates, amines, anilines, amides, hydrazines, nitrosyls, imides, nitro-ethers, anilines, nitro-ethers, amines, methylamines, imides, xylidine, 2,3-xylidine, ammonia, orthoborates, othroesters, orthoacids, oxides, oxalates, oxalic acids, peroxides, hydroperoxides, and phenols, said compound optionally containing at least one substituent selected from alkyl, alkyloxy, dialkyl, dialkyloxy, polyalkyl, polyalkyloxy, aryl, amide, acetate, aldehyde, carboethoxy, carbomethoxy, carbonyl, carbonyldioxy, carboxy, ethoxalyl, ethoxy, formyl, glycolyl, glyoxylyl, hydroxyl, imide, methoxy, or methylenedioxy radical, and mixtures thereof, iii. a COMBUSTION CATALYST

iv. as fuel additive to improve thermal efficiency of a fuel combusted in an engine or combustor.

11. The aforementioned compositions, wherein said

composition in combustion is characterized as having a luminous reaction zone extending some distance as compared to clear fuel, absent ECS compound and NLEC.

12. A fuel composition of claim 9 comprising a cyclopentadienyl manganese tricarbonyl compound and a dialkyl carbonic acid ester (dialkyl carbonate); and optionally a hydrocarbon.

13. A fuel composition of claim 12 comprising:

i. methyl cyclopentadienyl manganese tricarbonyl compound; and

ii. dimethyl carbonate

14. The compositions of claims 1-6, and 8-13, wherein said composition contains at least one compound selected from the group consisting of a polyolefin, polyacrylate, polymethacrylate, modified polystyrene, ethylene-vinyl acetate copolymer, or ethylene-vinyl chloride copolymer, and mixture.

15. The compositions of 5 -9 and 12-14, wherein said hydrocarbon is selected from the group consisting of: an alternative fuel, petroleum gas, liquefied petroleum gas, LPG-propane, LPG-butane, natural gas, natural gas liquids, methane, ethane, propane, n-butane, propane-butane mixture,

fuel methanol, fuel methanol 85, fuel ethanol, biomass fuel, vegetable ester fuel, rap seed methyl ester fuels, soybean fatty acid ester fuels, alkylate fuel, reformate fuel, isooctane fuel, paraffinic fuel, kerosine, wide range boiling fuel gas turbine fuel, gas turbine fuel No.O-GT, gas turbine fuel No.1-GT, gas turbine fuel NO.2-GT, gas turbine fuel No.S-GT, gas turbine fuel No.4-GT turbine fuel, aviation jet turbine fuels aviation jet turbine JP-4, aviation jet turbine JP-5, aviation jet turbine JP-7, aviation jet turbine JP-8, aviation jet turbine JP-9, aviation jet turbine JP-10, aviation jet turbine TS, aviation jet turbine Jet A-1, aviation jet turbine Jet A, aviation jet turbine Jet B, military aviation gasoline, missile fuel, solid and liquid rocket fuel, monopropellant, multipropellant fuel, hypergolic fuel, gas oil fuels, gas oil fuel #1, gas oil fuel #2, gas oil fuel #3, gas oil fuel #4, diesel fuel oil, diesel fuel oil Grade low sulfur No. 1-D, diesel fuel oil Grade low sulfur No. 2-D, diesel fuel oil Grade No. 1-D, diesel fuel oil Grade No. 2-D, diesel fuel oil Grade No 4-D, diesel fuel ,oil grade Type C-B, diesel fuel oil Type T-T, diesel fuel oil Type R-R, diesel fuel oil Type S-M, reformulated diesel fuel, low sulfur

hydrotreated low aromatic distillate fuel, toluene fuels, naphtha fuels, fuel oils, fuel oil Grade 1, fuel oil Grade 2, fuel oil Grade 4 (light), fuel oil Grade 4, fuel oil Grade 5 (light), fuel oil Grade 5 (heavy), fuel oil Grade 6 fuel oil, heavy marine diesel fuel, heavy railroad diesel fuel oil, distillate oil, distillate fuels, residual type oils, cycle oils, light cycle oils, light cycle gas oils, heavy cycle oils, heavy gas cycle oils, heating oils, vacuum oils, burner oils, furnace oils, coal liquids, middle distillate coal fuels, powdered coals, coal, tar sand fuels, shale oil fuels, hydrazines, ammonia, acetylene, and mixtures thereof.

16. The aforementioned rocket fuel composition, wherein said composition contains 0.01% to 53.0% oxygen by weight,

a. optionally a rocket propellant selected from the group consisting of hydrogen, hydrocarbon fuels, dimethyl carbonate, acetylene, aluminum borohydride, ammonia, aniline, benzene, butane, butyl mercaptan, diborane, diesel, diethylenetriamine, ethane, ethanol, ethylamine, ethylene diamihe, ethylene oxide, ethyl nitrate, furfuryl alcohol, gasoline, heptene, hydrazine (including substitutes), isopropyl alcohol, lithium, lithium hydride, kerosine, naptha, napthalene, methane, methylal, methanol, methylamine,

nitromethane, nitroethane, nitropropane, n-octane, propane, n-propyl nitrate, o-toluidine, salicyl aldehyde, triethylamine, trimethyl trithiophosphite, turpentine, unsymmetrical dimethyl hydrazine, 2,3-xylidene, lithium borohydride, monomethylhydrazine, pentaborane, ethylene, propylene, tertiary butylcumyl peroxide, butylene, 1,2-butadiene, 1, 3-butadiene, actetylene hydrocarbons, allylene, butine-1, pentine-1, hexine-1; substituted hydrazineis, including methylhydrazine, symmetrical dimethylhydrazine, unsymmetrical dimethylhydrazine, hydrazine, hydrozides, ethane, propane, butane, diborane, tetraborane, penta bornane, hexaborane, decaborane, aluminum borohydride, beryllium borohydride, lithium borohydride, ammonium nitrate, potassium nitrate, nitric acid, ammonium azide, ammonium perchlorate, lithium perchlorate, potassium perchlorate, nitrogen trioxide, nitrogen dioxide, hydrazoic acid, dicyanogen, hydrocyanic acid, monethylanile, acetylene, aluminum borohydride, ammonia, aniline, benzene, butyl mercaptan, diborane, dimethylamine, diethylenetriamine, ethanol, ethylamine, ethylene diamine, ethylene oxide, ethylenediamine, ethyl nitrate, dimethyl sulfide, furfuryl alcohol, heptene, hydrazine, hydrogen, isoethyl nitrate,

isopropyl alcohol, lithium, lithium hydride, methyl nitrate, methylacetylene, methylvinyl acetylene, monoethylaniline, tetranitromethane,_nitroglycerine, n-octane, propane, propylene oxide, n-propyl nitrate, o-toluidine, triethylamine, trimethylamine, trimethyl trithiophosphite, turpentine, unsymmetrical dimethyl hydrazine, xylidine, 2,3-xylidine, lithium borohydride, monomethylhydrazine, pentaborane, trimethylaluminum or dimethylberyllium and mixture

b. optionally an oxidizer selected from the group consisting of liquid oxygen, nitric acid, mixed nitric acid sulfuric acid combinations, fluorine, nitrogen tetroxide, hydrogen peroxide, hydroperoxide, potassium perchlorate, perchloryl fluoride, bromine pentafluoride, chlorine trifluoride, ON 7030, ozone, oxygen difluoride, RFNA (at various strengths), WFNA, tet rani tromethane, fluorine, chlorine, chlorine trifluoride, perchloryl fluoride, nitrosyl fluoride, nitryl fluoride, N2O4, nitrogen trifluoride, difluorine monoxide, fluorate, or chlorine oxides and mixture.

17 . The aforementioned rocket fuel composition, whereupon combustion specific impulse is not less than 200 I_{sp} Sec./250

18. The aforementioned rocket fuel composition, whereupon combustion engine combustion wall temperature does not exceed the range of 1,300°F to 2,000°F

19. The aforementioned diesel, fuel oil, turbine oil, or aviation jet fuel compositions, wherein said composition contains a cyclopentadienyl manganese tricarbonyl (CMT) compound, and is a fuel composition characterized as being a:

No. 1 (low sulfur) diesel fuel having a minimum LHV of 75 BTU/lb, a minimum cetane number of 40, a maximum of 35%. wt. aromatic content, a maximum T-90 temperature of 288°C, a maximum kinematic viscosity of 2.4 mm^2/S at 40°C, a maximum sulfur content 0.05% mass, a maximum ash content of 0.01 percent mass, and a minimum flash point of 38°C;

No. 1 diesel fuel having a minimum cetane number of 40, a maximum of 35% wt. aromatic content, a maximum T-90 temperature of 288°C, a maximum kinematic viscosity of 2.4 mm^2/S at 40°C, a maximum ash content of 0.01 percent mass, and a minimum flash point of 38°C;

A No. 1 Diesel fuel oil, wherein said composition contains 0.01% to 53.0% oxygen by weight and is for use as a, having at least one of the following characteristics: a

cetane number of at least 40, a maximum of 35% wt. aromatic content, a maximum T-90 temperature of 288°F, a maximum sulfur content 0.5% mass, a minimum kinematic viscosity of 1.3 mm^2/S at 40°C, a maximum kinematic viscosity of 2.4 mm^2/S at 40°C, a maximum ash content of 0.01 percent mass, a minimum flash point of 38°C, an API gravity of 40 to 44;

A #1 diesel fuel composition containing 0.01% to 53.0% oxygen by weight and characterized as having: a cetane number of at least 40, a maximum of 35% wt. aromatic content, a maximum T-90 temperature of 288°F, a maximum sulfur content 0.5% mass,.a minimum kinematic viscosity of 1.3 mm^2/S at 40°C, a maximum kinematic viscosity of 2.4 mm^2/S at 40°C, a maximum ash content of 0.01 percent mass, a minimum flash point of 38°C, an API gravity of 40 to 44;

No. 2 (low sulfur) diesel fuel having a maximum T-90 temperature of 338°C, a minimum cetane number of 40, a maximum of 35% wt. aromatic content, a maximum sulfur content not exceeding 0.05% mass, a maximum kinematic viscosity of 4.1 mm^2/S at 40°C, a maximum ash content of 0.01 percent mass, and a minimum flash point of 52 °C;

No. 2 diesel fuel having a maximum T-90 temperature of 338°C, a minimum cetane number of 40, a maximum of 35% wt. aromatic

content, a maximum kinematic viscosity of 4.1 mm^2/S at 40°C, a maximum ash content of 0.01 percent mass, and a minimum flash point of 52 °C;

No. 4 diesel fuel having a cetane number of at least 30, a maximum sulfur content not exceeding 2.0%, a maximum kinematic viscosity of 24.0 mm^2/S at 40°C (55°C) , a maximum ash content of 0.10 percent mass, and a minimum flash point of 55°C;

A diesel oil having a viscosity ranging from about 10 to 500' centistokes at 50°C, and a sulfur concentration ranging from 0.01 to 3.0% mass;

A heavy diesel, locomotive or marine fuel composition (meeting ISO DIS 8217 or BS MA 100 standards) having a sulfur concentration of 0.01 to 3.0% mass and a viscosity of 10 to 500 centistokes at 50°C;

A biodiesel composition containing methyl esters having a maximum sulfur content of 0.05 percent mass;

No. 0-GT turbine fuel oil composition having a maximum T-90 temperature of 288°C, a maximum kinematic viscosity of 2.1 mm^2/S at 40°C, a maximum sulfur content not exceeding 0.5% mass, a maximum ash content of 0.01% mass, and a minimum flash point of 38°C;

No. 1-GT turbine fuel oil composition having a maximum T-90

temperature 288°C, a maximum sulfur content not exceeding 0.5%, a maximum kinematic viscosity of 2.4 mm^2/S at 40°C, a maximum ash content of 0.01 % mass, a minimum flash point of 38°C, a maximum pour point temperature of -18 °C, an a maximum density of 850kg/m^3 at 15°C;

No. 2-GT turbine fuel oil composition having a maximum T-90 temperature 338°C, a maximum sulfur content not exceeding 0.5%, a maximum kinematic viscosity of 4.1 mm^2/S at 40°C, a maximum ash content of 0.01 % mass, a minimum flash point of 38°C, a maximum pour point temperature of -6 °C, and a maximum density of 876 kg/m at 15°C;

No. 3-GT turbine fuel oil composition having a minimum kinematic viscosity 5.5 mm^2/S at 40°C, a maximum kinematic viscosity of 50.0'mm^2/S at 100°C, a maximum ash content of 0.03 % mass, and a minimum flash point of 65°C;

No. 4-GT turbine fuel oil composition having a minimum kinematic viscosity 5.5 mm^2/S at 40°C, a maximum kinematic viscosity of 50.0 mm^2/S at 100°C, a minimum flash point of 66°C;

No. 1 fuel oil composition having a maximum T-90 temperature of 288°C, a maximum sulfur content not exceeding 0.5%, a maximum kinematic viscosity of 2.1 mm^2/S at 40°C for No. 1, a minimum flash point of 38°C, a maximum pour point

temperature of -18 °C, and a maximum density of 850kg/m^3 at 15°C;

No. 2 fuel oil composition having a maximum T-90 temperature 338°C, a maximum sulfur content not exceeding 0.5%, a maximum kinematic viscosity 3.4 mm^2/S at 40°C, a maximum pour point temperature of -6 °C, a maximum density of 876 kg/m^3 at 15°C, and a minimum flash point of 38°C;

No. 4' (light) fuel oil composition having a maximum kinematic viscosity 5.5 mm^2/S at 40°C; a maximum ash content of 0.05 percent mass, a maximum pour point temperature of -6 °C, a minimum density of 876 kg/m^3 at 15°C, and a minimum flash point of 38°C;

No. 4 fuel oil composition having a minimum kinematic viscosity 5.5 mm^2/S at 40°C, a maximum kinematic viscosity 24 mm^2/S at 40°C, a maximum ash content of 0.10 percent mass, a maximum pour point temperature of -6 °C, and a minimum flash point of 55°C;

No. 5 (light) fuel oil composition having a minimum kinematic viscosity 5.0 mm^3/S at 100°C, a maximum kinematic viscosity 8.9 mm^3/S at 100°C, a maximum ash content of 0.15 percent mass, and a minimum flash point of 55°C;

No. 5 (heavy) fuel oil composition having a kinematic

viscosity 9.0 mm^3/S at 100°C, a maximum kinematic viscosity 14.9 mm^3/S at 100°C, a maximum ash content of 0.15 percent mass, and a minimum flash point of 55°C;

No. 6 fuel oil composition;

An aviation turbine composition having a maximum aromatic content of 25% vol., a maximum mercaptan sulfur of 0.003 weight %, a maximum total sulfur content of 0.3 weight %, a maximum T-10 distillation fraction temperature of 205°C, a maximum final boiling temperature of 300°C, a minimum flash point temperature of 38°C, a density ranging from 775 to 840 kg/m @ 15°C, a freezing point temperature no warmer than -40°C, and a maximum viscosity of 8.0 mm^2/s;

An aviation turbine composition having a maximum T-20 distillation fraction temperature of 145°C, a maximum T-90 temperature of 245°C, a density ranging from 751 to 8.02 kg/m^2 @ 15°C, maximum vapor pressure of 21 kPa @ 38°Ci, and a freezing point temperature no warmer than -50°C;

An aviation turbine composition having a maximum total sulfur content of 0.3 wt %, a maximum T-50 distillation fraction temperature of 232°C, a maximum end point temperature of 300°C, a specific gravity of 57 API, a maximum viscosity of 15.0 Cs @ -34.4°C, and a freezing point

temperature no warmer than -50°C;

An aviation turbine composition having a maximum aromatic content of 25% vol., a maximum mercaptan sulfur of 0.003 weight %, a maximum total sulfur content of 0.3 weight %, a maximum T-10 distillation fraction temperature of 205°C, a maximum final boiling temperature of 300°C, a minimum flash.point temperature of 38°C, a density ranging from 775 to 840 kg/m @ 15°C, a freezing point temperature no warmer than -40°C, a maximum viscosity of 8.0 mm^2/s;

An aviation turbine composition having a maximum aromatic content of 25% vol., a maximum mercaptan sulfur of 0.002 weight %, a maximum total sulfur content of 0.3 weight %, maximum olefin content of 5.0% vol., a maximum T-10 distillation fraction temperature of 205°C, a maximum final boiling temperature of 330°C, a minimum flash point temperature of 38°C, API gravity 37-51, a density ranging from 775 to 840 kg/m^2 @ 15°C, a freezing point temperature no warmer than -40°C, a maximum viscosity of 8.0 mm^2/s, and maximum acidity of 0.015 mg KOH;

20. The aforementioned compositions, wherein said fuel is an aviation gasoline containing a cyclopentadienyl manganese tricarbonyl (CMT) compound , wherein said fuel is characterized

as being a fuel selected from the group consisting of:

a. An aviation turbine fuel composition containing 0.01% to 53.0% oxygen by weight and characterized as having: a maximum aromatic content of 22% vol., a maximum mercaptan sulfur of 0.003 weight %, a maximum total sulfur content of 0.3 weight %, a maximum T-10 distillation fraction temperature of 205°C, a maximum final boiling temperature of 300°C, a minimum flash point temperature of 38°C, a density ranging from 775 to 840 kg/m^2 @ 15°C, a freezing point temperature no warmer than -40°C, a maximum viscosity of 8.0 mm/s;

b. An aviation gasoline composition containing 0.001 to 10.0 oxygen weight percent supplied by an ECS oxygenate selected from the group consisting of methyl tertiary butyl ether, ethyl tertiary butyl ether, methyl tertiary amyl ether, methyl,tertiary amyl ether, diisopropyl ether, dimethyl carbonate, diethyl carbonate, and mixture; the cyclopentadienyl manganese tricarbonyl compound in concentration of 0.001 to 1.0 Mn/gal, wherein said fuel has a maximum 10% evaporated point of 167° F, a maximum 90% evaporated point of 275° F, a minimum Reid vapor pressure of 5.5 psi, and a maximum Reid vapor pressure of 7.0 psi, a maximum freezing point of -76°F, and a maximum sulfur

concentration of 0.05 percent weight

c. An aviation gasoline composition having a minimum combined 10% + 50% evaporated temperature of 307° F, a minimum lean octane number of 100, and a minimum heating value of 18, 700 Btu/lb;

21. The aforementioned compositions, wherein said fuel is an automotive gasoline containing a cyclopentadienyl manganese tricarbonyl (CMT) compound, wherein said fuel is:

a. An automotive gasoline composition having a maximum sulfur concentration of 300 ppm, a maximum aromatic concentration of 25% volume, a maximum olefin concentration (excluding C4-C5 olefins) of 10% volume, a maximum benzene concentration of 1.0%, a maximum T 90 temperature of 330°F, a minimumT-50 temperature of 175°F, a minimum octane (R+M)/2 number of 84, at least one deposit control additive selected from the group consisting of combustion chamber deposit control additives, port fuel injector additives, intake valve control additives;

b. An unleaded, phosphorus free gasoline composition fuels having a max RVP of 8.0, psi, a max of 8.0%, 20-25% vol. aromatics, a max of 1.0% benzene, 40- 300 ppm sulfur, an 02 concentration ranging up to 3.5% 02 by weight, a max T-90

temperature of 300°F to 320°F, a T-50 temperature of 170°F to 220°F; a minimum latent heat of vaporization of 900 BTU/gal @ 60°F, a minimum heating value of 106,000 BTU/gal @ 60°F, and a minimum average laminar burning velocity at ambient conditions of 48 cm/sec;

c. Automotive gasoline composition having a maximum T-90 distillation fraction temperature of 350°F, and a minimum T-50 distillation fraction of 150°F;

d. An automotive gasoline, wherein said composition contains 0.01% to 53.0% oxygen by weight and having at least one of the following characteristics:: a LHV of at least 860 BTU/gal, a laminar BStf at least 45 cm/sec; and said fuel having at least one of__the following: a sulfur content ranging from 0 to 300 ppm, a maximum polynuclear free aromatic concentration of 0% to 25% volume, a maximum olefin concentration (excluding C4-C5 olefins) of 10% volume, a maximum benzene concentration of 1.0%, a maximum T 90 temperature of 330°F, a minimumT-50 temperature of 175°F, a minimum octane (R+M)/2 number of 87, a deposit control additive selected from the group consisting of combustion chamber deposit control additives, port fuel injector additives, intake valve control additives, and mixture;

e. A automotive gasoline composition containing 0.01% to 53.0% oxygen by weight and characterized as having: a LHV of at least 860 BTU/gal, a laminar BV of at least 45 cm/sec; and said fuel having at least one of the following: a sulfur content ranging from 0 to 300 ppm, a maximum polynuclear free aromatic concentration of 0% to 25% volume, a maximum olefin concentration (excluding C4-C5 olefins) of 10% volume, a maximum benzene concentration of 1.0%, a maximum T 90 temperature of 330°F, a minimumT-50 temperature of 175°F, a minimum octane (R+M)/2 number of 87, a deposit control additive selected from the group consisting of combustion chamber deposit control additives, port fuel injector additives, intake valve control additives, and mixture.

22. The aforementioned aviation gasoline compositions, wherein the maximum end boiling point is 156°C (313°F).

23. The aforementioned automobile gasoline compositions, wherein the maximum T-90 distillation fraction boils at 149°C (300°F).

24. The aforementioned automobile gasoline compositions, wherein the maximum T-90 distillation fraction boils at 143°C (290°F).

25. The aforementioned automobile gasoline

compositions, wherein the maximum T-90 distillation fraction boils at 138°C (280°F).

26. The aforementioned automobile gasoline compositions, wherein the maximum T-90 distillation fraction boils at 132°C (270°F).

27. The aforementioned automobile compositions, wherein the minimum T-50 distillation temperature is 175°F.

28. The aforementioned automobile compositions, wherein the minimum T-50 distillation temperature is 180°F.

29. The aforementioned automobile compositions, wherein the maximum T-50 distillation temperature is 220°F.

30. The aforementioned automobile compositions, wherein the maximum T-50 distillation temperature is 210°F.

31. The aforementioned # 1 diesel, gas turbine, fuel oil and jet turbine fuel oil compositions, wherein the maximum T-90 distillation fraction temperature is 282°C;

32. The aforementioned # 1 diesel, gas turbine, fuel oil and jet turbine fuel oil compositions, wherein the maximum T-90 distillation fraction temperature is 273°C;

33. The aforementioned # 2 diesel, gas turbine, fuel oil and jet turbine fuel oil compositions, wherein the

maximum T-90 distillation fraction temperature is 294°C.

34. The aforementioned # 2 diesel, gas turbine, fuel oil and jet turbine fuel oil compositions, wherein the maximum T-90 distillation fraction temperature is 285°C.

35. The aforementioned automobile and aviation gasoline compositions characterized as having a minimum LHV of 860 BTU/gallon @ 60°F.

36. The aforementioned automobile and aviation gasoline compositions characterized as having a minimum LHV of 880 BTU/gallon @ 60°F.

37. The aforementioned automobile and aviation, gasoline compositions characterized as having a minimum. LHV of 900 BTU/gallon @ 60°F.

38. The aforementioned automobile and aviation gasoline compositions characterized as having a minimum LHV of 905 BTU/gallon @ 60°F.

39. The aforementioned diesel, gas turbine oil, fuel oil, aviation fuel oil compositions, wherein the minimum LHV is 75 Btu/lb.

40. The aforementioned diesel, gas turbine oil, fuel oil, aviation fuel oil compositions, wherein the minimum LHV is 100 Btu/lb.

41. The aforementioned aviation gasoline compositions, wherein the minimum LHV is 140 Btu/lb.

42. The aforementioned aviation gasoline and automobile gasoline compositions, wherein the minimum LHV is 150 BtuAb.

43 . The aforementioned aviation and automobile gasoline compositions, wherein the minimum LHV is 160 Btu/lb.

44 . The aforementioned aviation and automobile gasoline compositions, wherein the minimum LHV is 170 Btu/lb.

45. The aforementioned compositions, wherein said composition contains a compound selected from the group consisting a peroxide, di-tertiary butyl peroxide, 2.5 dimethyl 2.5 di(tertiary butyl peroxy) hexane, tertiary butylcumyl peroxide, di(tertiaryamyl) peroxide), an alkyl peroxide, an alkyl hydroperoxide, tertiary butyl hydroperoxide, tertiary amyl hydroperoxide, an alkyl nitrate, ethyl-hexyl nitrate, iso-propyl nitrate, nitrobenzene, aniline, amine, imide, and mixtures thereof.

46. The aforementioned compositions containing a metal deactivator, optionally selected from the group consisting of N,N^1-disalicylidene-1,2-propane diamine, NjN^1-disalicylidene-1,2-ethane diamine or N,N^1-disalicylidene-1,2-cyclohexanediamine.

47. The forementioned compositions containing least one engine, carburetor, induction, injection system cleaning or deposit control additive, detergent or dispersant, optionally selected selected from the group consisting of a polyether amine, polyether amide amines, polyalkenyl succinimide, or polyalkenyl succinimide, hydrocarbyl carbonates, polybutene alcohol, polybutene chloroformate, polybutene amines formulated in mineral or other carriers, polyisobutylene amine reformulated in polyether carriers, one-component polyether amines, polyether amines, polyalkenyl amines, alkenyl succinimides, long-chain dibasic acid derivative, long-chain aliphatic polyamines or long chain Mannich bases, and mixture

48. The aforementioned compositions, wherein said composition contains at least one detergent, ashless detergent, alkenyl succinic acid ester, alkenyl succinimide of an amine, methlyamine, 2-ethylhexylamine, n-dodecylamine,

polyether amine, polyalkenyl amine, alkenyl succinimide, polyether amide amine, antioxidant, demulsifer, emulsifer, corrosion inhibitor, aromatic solvent, scavenger, rust inhibitors, surfactants, supplemental valve, valve seal recession protectants, diluent oil, mutual solvent, or metal deactivator, and mixture.

49. The aforementioned compositions, wherein said composition contains an antioxidant, optionally selected from the group consisting alkyl phenol,aromatic diamines with sterially hindered phenolic and amine groups, 2,6 di-tert-butylephenol; 2,4,6-tri-tert-butylephenol; 4-methyl-2,6 di-tert-butylephenol; 2-tert-butylphenol, 2,6-di-tert-butyl-p-cresol, phenylenediamines, mixtures of tertiary butylated phenols, aromatic amines, N,N—diisopropylparaphenylene diamine, seventy-five percent minimum 2,6-di-tertiary-butyl phenol plus 25% maximum tertiary and tritertiary butyl phenols, seventy-two percent minimum 2,4-dimethyl-6-tertiary-butyl phenol plus 28% maximum monomethyl and dimethyl tertiary-butyl phenols, fifty-five percent minimum 2,4-dimethyl-6-tertiary-butyl phenol plus 45% maximum mixed tertiary and ditertiary butyl phenols, 2,6-di-tert-butyl-4-methylphenol,

6-tert-butyl-2,4-dimethylphenol, 2,6-di-tert-butylphenol, 75 percent min-2, 6-di-tert-butylphenol 25 percent max tert-butylphenols and tri-tertbutylphenols, 72 percent min 6-tert-butyl-2, 4-dimethylphenol 28 percent max tert-butyl-methylphenols and tert-butyl-dimethylphenols, 55 percent min 6-tert-butyl-2, 4-dimethylphenol 45 percent max mixture of tert-butylphenols and ditert-butylphenols, 60 to 80 percent 2,6-dialkyphenols 20 to 40 percent mixture of 2,3,6-trialkylphenols and 2,4,6-trialkylphenols, 35 percent min 2,6-di-tert-butyl-4-methylphenol 65 percent max mixture of methyl-, ethyl-, and dimethyl-tert-butylphenols, 60 percent min 2,4-di-tert-butylphenol 40 percent max mixture of tert butylphenols, 30 percent min mixture of 2,3,6-trimethylphenol and 2,4,6-trimethylphenol 70 percent max mixture of dimethylphenols, 55 percent min butylated ethylphenols 45 percent max butylated methyl- and dimethylphenols, 45 percent mix 4,6-di-tert-butyl-2-methylphenol, or 40 percent min mixture of 6-tert-butyl-2 -methylphenol 15 percent max mixture of other butylated phenols, and mixture.

50. The aforementioned compositions, wherein said composition contains an inhibitor, optionally selected from the group consisting of: 2, 4-dimethyl-6-tertiary-butyl phenol,

2, 6-detertiary-butyl-4-methyl phenol, 2, 6-ditertiary-butyl phenol, 75% 2, 6-ditertiary-butyl phenol, 10-15% 2, 4, 6-tritertiary-butyl phenol, 10-15% orthy-tertiary butyl phenol, 72% min 2, .4-dimethyl-6-tertiary butyl phenol, 28% max. monemethyl and dimethyl tertiary butyl . phenol, 60% min 2, 4-ditertiary-butyl phenol, 40% max, mixed, or tertiary-butyl phenol and mixture.

51. The aforementioned automobile and aviation gasoline compositions characterized as having a minimum laminar Bunsen burner flame velocity of 46 cm/sec at ambient, conditions benchmark of methanol at 57.2 cm/sec).

52 . The aforementioned automobile and aviation gasoline compositions characterized as having a minimum laminar Bunsen burner flame velocity of 48 cm/sec at ambient conditions (benchmark of methanol at 57.2 cm/sec).

53 . The aforementioned automobile and aviation gasoline compositions characterized as having a minimum laminar Bunsen burner flame velocity of 50 cm/sec at ambient conditions (benchmark of methanol at 57.2 cm/sec).

54 . The aforementioned automobile and aviation gasoline compositions characterized as. having a minimum laminar Bunsen burner flame velocity of 55 cm/sec at ambient

conditions (benchmark of methanol at 57.2 cm/sec).

55. The aforementioned automobile and aviation gasoline compositions characterized as having a minimum laminar Bunsen burner flame velocity of 60 cm/sec at ambient conditions (benchmark of methanol at 57.2 cm/sec).

56. The aforementioned automobile and aviation gasoline compositions characterized as having a minimum laminar Bunsen burner flame velocity of 70 cm/sec at ambient conditions (benchmark of methanol at 57.2 cm/sec).

57. The aforementioned gasoline compositions, wherein said contain an antiknock quantity of an agent selected from the group consisting of cyclopentadienyl nickel nitrosyl, n-methyl aniline, 2.4 pentanedione, arid mixture.

58. The aforementioned compositions , wherein said ECS compound is selected from the group consisting C2-C12 aldehydes, C2-C12 ethers, diethers, Cl - C15 alcohols, C2-C12 oxides , G3 - C15 ketones, C3 -CIS esters , C3 - C12 diesters, C5 - C12 phenols, glycols, C3-C20 glycol ethers, C4-C20 carbonates, C5-C25 dicarbonates, organic/inorganic peroxides/ hydroperoxides, nitrates, di-nitrates, alkylnitrates, anilines, nitro-ethers, amines, amides,

nitrosyls, imides, monethylanile, aniline, ethylenediamine, isoethyl nitrate, methylamine, monoethylaniline, nitromethane, nitropropane, nitroglycerine, n-propyl nitrate, o-toluidine, triethylamine, trimethylamine, hydrazines, dimethyl hydrazine, monomethylhydrazine, methylhydrazine, symmetrical dimethylhydrazine, unsymmetrical dimethylhydrazine, xylidine, 2,3-xylidine,ammonia, ammonium nitrate, potassium nitrate, nitric acid, ammonium azide, ammonium perchlorate, nitrogen trioxide, nitrogen dioxide, hydrazoic acid, dicyanogen, hydrocyanic acid, and mixture.

59. The rocket fuel composition containing a compound selected from the group consisting of hexine-1; substituted hydrazines, including methylhydrazine, symmetrical dimethylhydrazine, unsymmetrical dimethylhydrazine, hydrazine, acyl hydrazine (hydrozides); ethane, propane, butane, diborane, tetraborane, penta.bornane, hexaborane, decaborane, aluminum borohydride, beryllium borohydride, lithium borohydride, ammonium nitrate, potassium nitrate, nitric acid, ammonium azide, ammonium perchlorate, lithium perchlorate, potassium perchlorate, nitrogen trioxide, nitrogen dioxide, hydrazoic acid, dicyanogen, hydrocyanic acid, monethylanile, acetylene, aluminum borohydride, ammonia, aniline, benzene, butyl

mercaptan, diborane, dimethylamine, diethylenetriamine, ethanol, ethylamine, ethylene diamine, ethylene oxide, ethylenediamine, ethyl nitrate, dimethyl sulfide, furfuryl alcohol, heptene, hydrazine, hydrogen, isoethyl nitrate, isopropyl alcohol, lithium, lithium hydride, methane, methylal, methanol, methyl nitrate, methylamine, methylacetylene, methylvinyl acetylene, monoethylaniline, tetranitromethane nitromethane, nitropropane, nitroglycerine, n-octane, propane, propylene oxide, n-propyl nitrate, o-toluidine, triethylamine, trimethylamine, trimethyl trithiophosphite, turpentine, unsymmetrical dimethyl hydrazine, xylidine, 2,3-xylidine, lithium borohydride, monomethylhydrazine, pentaborane, monethylanile, ethylenediamine, isoethyl nitrate, methylamine, monoethylaniline, nitroglycerine, n-propyl nitrate, o-toluidine, triethylamine, trimethylamine, hydrazines, dimethyl hydrazine, monomethylhydrazine, methylhydrazine, symmetrical dimethylhydrazine, unsymmetrical dimethylhydrazine,tetranitromethane, hydrozide, xylidine, 2,3-xylidine, ammonium nitrate, potassium nitrate, nitric acid, ammonium azide, ammonium perchlorate, nitrogen trioxide, nitrogen dioxide, hydrazoic acid, dicyanogen, hydrocyanic acid, OHC(CH2)4CHO; CH3CHOHCHOHCH3; (CH3)3CCHOHCH3;

CH2CH2C(CH3)(OH)CH3; (CH3)2COOH; CH3CCCOH;(CH3)3CCH2COH; HOCH2CH2OCH2CH2OH; HOCH2CH2OH; OCH2CHCHO; (CH3)3CCHO; (CH3)3CCH(OH)CH3; C5H4O2; HO2CCH2CH2C02C2H5; C3H7COCO2H; C5H802, and others.

60. The aforementioned compositions containing a glycol, or a glycol ether selected from the group consisting of ethylene glycol monomethyl, diethylene glycol dimethyl ether, diethylene glycol diethyl ether, diethylene glycol dimethyl ether, diethylene glycol diethyl ether, diethylene glycol dipropyl ether, diethylene glycol dibutyl ether, [including] diethylene glycol monomethyl ether, diethylene glycol monoethyl ether, diethylene glycol monobutyl ether, diethylene glycol dimethyl ether, diethylene glycol diethyl ether, glycol monomethyl ether, glycol dimethyl ether, diethylene glycol diethyl ether, diethylene glycol dimethyl ether, diethylene glycol diethyl ether, C3[5]-C20 glycol ethers (including ethylene glycol monoalkyl ethers (ethylene glycol monomethyl ether), diethylene glycol monoalkyl ethers diethylene glycol dialkyl ethers, including , diethylene glycol dimethyl ether, diethylene glycol diethyl ether, diethylene glycol dipropyl ether,, diethylene glycol dibutyl ether, [including] diethylene glycol monomethyl ether, diethylene glycol

monoethyl ether, diethylene glycol monobutyl ether), ethylene glycol monomethyl ether, diethylene glycol dimethyl ether (or diethylene glycol diethyl ether, ethers of ethylene glycol, ethylene glycol monomethyl ether or diethylene glycol monomethyl etherEthylene Glycol Monomethyl Ether, (EGME), 1–Ethylene glycol monomethyl ether, diethylene glycol monomethyl ether, diethylene glycol dimethyl ether, diethylene glycol diethyl ether, methylene di methyl ether (also known as methylal, dimethoxy methane, ethylene glycol and mixture.

61. The aforementioned compositions wherein the ECS compound has a minimum average boiling temperatures of no less than 32°C (90°F).

62. The aforementioned compositions wherein the ECS compound has a minimum average boiling temperatures of no less than 32°C (90°F).

63. The aforementioned compositions wherein the ECS compound is OHC(CH2)4CHO; CH3CHOHCHOHCH3; (CH3)3CCHOHCH3; CH2CH2C(CH3)(OH)CH3; (CH3)2COOH; CH3CCCOH; (CH3)3CCH2COH; HOCH2CH2OCH2CH2OH; HOCH2CH2OH; OCH2CHCHO; (CH3)3CCHO; (CH3)3CCH(OH)CH3; C5H4O2; HO2CCH2CH2CO2C2H5; C3H7COC02H; C5H8O2,

64. The aforementioned compositions wherein the ECS

compound has one or more radical (s) selected from group consisting of OO, CO, F, F2, F3, N, B, Be, BO, B2, BF, AL ALO, CH3, NH3, CH, C2H2, C2H5, Li, ONH, NH, NH2, OCH_3, . OC2H5, OCH, OCH_2/ OH, Cl, OCOO, COOH, C2H5OOC, CH3CO, OCH2O, OCHCO, or CONH2, and combination.

65. The aforementioned compositions wherein the ECS compound has a minimum enthalpy of vaporization (at it evaporation pgint) of 24 jK $mole^{-1}$

66. The aforementioned compositions wherein the ECS compound has a minimum enthalpy of vaporization of 28 jK $mole^{-1}$

67. The aforementioned compositions wherein the ECS compound has a minimum enthalpy of vaporization of 30 jK mole"[1]

68. The aforementioned compositions wherein the ECS compound has a minimum enthalpy of vaporization of 32 jK $mole^{-1}$

69. The aforementioned compositions wherein the ECS compound has a minimum Bunsen Burner Laminar velocity (with methanol at 57.2 cm/sec) of 45 cm/sec

70. The aforementioned compositions wherein the ECS compound has a minimum Bunsen Burner Laminar velocity

(with methanol at 57.2 cm/sec) of 48 cm/sec

71. The aforementioned compositions wherein the ECS compound has a minimum Bunsen Burner Laminar velocity (with methanol at 57.2 cm/sec) of 55 cm/sec.

72. The aforementioned compositions wherein the ECS compound has a minimum Bunsen Burner Laminar velocity (with methanol at 57.2 cm/sec) of 57 cm/sec

73. The aforementioned compositions wherein the ECS compound is selected from carbon monoxide, methylene di methyl ether, methylene di ethyl ether, methylene di propyl ether, methylene di butyl ether, methylene di isopropyl ether, methane hydrate, dimethyl carbonate, diethyl carbonate, dipropyl carbonate, diisopropyl carbonate, glycol, and glycol ethers.

74. The aforementioned compositions wherein the ECS compound is selected from C3 to C11 dialkyl carbonates, C2 -C8 ethers, dual or multiple-linkage ethers, glycols, glycol ethers, peroxides, hydroperoxides, and mixture.

75. The aforementioned compositions wherein the ECS compound is selected from dimethyl ether, diisopropyl ether, methyl tertiary butyl ether, ethyl tertiary butyl ether, ethyl tertiary amyl ether, methyl tertiary amyl

ether, and diisopropyl ether.

76. The aforementioned compositions wherein the ECS compound is selected from acid dimethyl ester (dimethyl carbonate), carbonic acid diethyl ester (diethylcarbonate) and mixture.

77. The aforementioned compositions wherein the ECS compound is selected from of methanol, ethanol, iso-propanol, tertiary butanol, iso-butanol, and mixture thereof.

78 . The aforementioned compositions wherein the ECS compound is selected from group consisting of amines, amides, nitrates, di-nitrates, or nitro ethers, and mixture,

79. The aforementioned automotive gasoline compositions where the ECS compound is ethanol.

80. The aforementioned automotive gasoline compositions where the ECS compound is methanol.

81. The aforementioned automotive gasoline compositions where the ECS compound is MTBE.

82. The aforementioned automotive gasoline compositions where the ECS compound is methylal.

83. The aforementioned automotive gasoline compositions where the ECS compound is di-tertiary butyl

peroxide.

84. The aforementioned compositions, where said ECS compound contributes oxygen in the range from 0.001 to 50.0 percent by weight of the composition.

85. The aforementioned compositions, where said ECS compound contributes greater than 1.0% 02 by weight to the composition.

86. The aforementioned compositions, where said ECS compound contributes least 1.5% O2 by weight to the composition.

87. The aforementioned gasoline, diesel, fuel oil, gas turbine oil, jet aviation turbine compositions, where said ECS compound contributes greater than 1.(5% 02 by weight to the composition.

88. The aforementioned compositions, where said ECS compound contributes greater than 1.5% 02 by weight to the composition.

89. The aforementioned compositions, where said ECS compound contributes least 2.0% O2 by weight to the composition.

90. The aforementioned compositions, where said ECS compound contributes least 2.5% O2 by weight to the composition.

91. The aforementioned compositions, where said ECS compound contributes least 3.5% O2 by weight to the composition.

92. The aforementioned compositions, where said ECS compound contributes least 4.5% O2 by weight to the composition.

93. The aforementioned compositions, where said ECS compound contributes 0.01% to 53.0% 02 by weight to the composition.

94. The aforementioned compositions, wherein said non-lead element or combustible compound containing said element is selected from the group consisting of Li, Be, B, N, F, Na, Mg, Al, Si, P, S, Cl, K, Ca, Sc, Ti, V, Cr, Mn, Fe, Co, Ni, Cu, Zn, Ga, Ge, Br, Rb, Sr, Y, Zr, Nb, Mo, Tc, Ru, Rh, Pd, Ag, Cd, In, Sn, I, Cs, Ba, La, Ce, Pr, Nd, Pm, Sm, Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb, Lu, Hf, Ta, W, Re, Os, Ir, Pt, Au, Hg, Ti, Fr, Ra, Ac, Th, Pa, U, Np, Pu, Am, Cm, Bk, Cf, Es, Fm, Md, No, Lr, Unq, Unp, Unh, Uns elements of the Periodic Chart of Elements, and mixtures thereof,

wherein said element or its organic or inorganic compound being present in combustible form;

95. The aforementioned compositions, wherein said non-lead element or or combustible compound containing said element is selected from the group consisting of Li, Be, B, F, N, Na, Mg, Al., Si, P, S, Cl, K, Ca, Sc, Ti, V, Cr, Mn, Fe, Co, Ni, Cu, Zn, Ga, Ge, Br, Rb, Sr, Y, Zr, Nb, Mo, Tc,Ru, Rh, Pd, Ag, Cd, In, Sn, I, Cs, Ba, Hf, Ta, W, Re, Os, Ir, Pt, Au, Hg, Ti, Fr, Ra, Ac, Th, Pa, U, Np, Pu, Am, Cm, Bk, Cf, Es, Fm, Md, No, Lr, Unq, Unp, Unh, Uns elements of the Periodic Chart of Elements, and mixtures thereof, wherein said element or its organic or inorganic compound being present in combustible form.

96. The aforementioned compositions, wherein said non-lead element or compound containing said element is selected from the group consisting of Li, Be, B, F, N, Na, Mg, Al, Si, P, S, Cl, K, Ca, Sc, Ti, V, Cr, Mn, Fe, Co, Ni, Cu, Zn, Ga, Ge, Br, and mixture thereof, wherein said element or its organic or inorganic compound being present in combustible form.

97. The aforementioned compositions, wherein said non-lead element or compound containing said element is selected

from the group consisting of Li, B, F, Na, Mg, Al, Si, P, S, Cl, K, Ca, Sc, Ti, V, Cr, and mixture thereof, wherein said element or its organic or inorganic compound being present in combustible form.

98. The aforementioned compositions, wherein said non-lead element or compound containing said element is selected from the group consisting of Li, Be, B, F, N, Na, Mg, Al, Si, P, S; Cl, K, Ca, Sc, Ti, V, Cr, Mn, Fe, Co, Ni, Cu, Zn, Ga, Ge, Br, Rb, Sr, Y, Zr, Nb, Mo, Tc, Ru, Rh, Pd, Ag, Cd, In, Sn, I, Cs and mixture thereof, wherein said element or its organic or inorganic compound being present in combustible form.

99. The aforementioned compositions, wherein said non-lead element or compound containing said element is selected Be, F, Si, P, Cl, Ca, Sc, Ti, V, Cr, Co, Ni, Cu, Zn, Ga, Ge, Br, Rb, Sr, Y, Zr, Nb, Mo, Tc, Ru, Rh, Pd, Ag, Cd, In, Sn, I, Cs, elements of the Periodic Chart of Elements,, and mixtures thereof, wherein said element or its organic or inorganic compound being present in combustible form;

100. The aforementioned compositions, wherein said non-lead element or compound containing said element is selected from the group consisting elements of groups 1A, 2A, 3A, IB,

2B, 3B, 4B, 5B, 6B, 8 (CAS version), and iodine, bismuth, germanium, phosphorus, silicon, nitrogen, sulfur, fluorine, chlorine and tin and mixture thereof, wherein said element or its organic or inorganic compound being present in combustible form;

101. The aforementioned compositions, wherein said non-lead element or compound containing said element is selected from the group consisting of phosphorous, magnesium, manganese, silicon, iron, aluminum, or boron and mixture, wherein said element or its organic or inorganic compound being present in combustible form.

102. The aforementioned compositions, wherein said non-lead element or compound containing said element is selected from the group consisting of lithium, sodium, potapsium, rhubidium, or, cesium and mixture, wherein said element or its organic or inorganic compound being present in combustible form.

103. The aforementioned compositions, wherein said non-lead element or compound containing said element is selected from the group consisting of potassium, Silicon, manganese and mixture, wherein said element or its organic or inorganic compound being present in combustible form.

104. The aforementioned compositions containing Mn and wherein said composition additionally contains a non-lead element or compound containing said element selected from the group of elements of groups 1A, 2A, 3A, IB, 2B, 3B, 4B, 5B, 6B, 7B, 8, and from iodine, bismuth, germanium, phosphorus, silicon, nitrogen, sulfur, fluorine/ chlorine or tin and mixture thereof, wherein said element or its organic or inorganic compound being present in combustible form.

105. The aforementioned compositions, wherein said non-lead element is contained in compound containing one or more alkyl, dialkyl, aryl, amide, alkenyl, aralkyl, aralkenyl, cycloalkyl, cycloalkenyl, aldehyde, carbethoxy, carbornethoxy, carbonyl, carbonyldioxy, carboxy, ether, acetate, ketonic, ethoxalyl, ethoxy, formyl, glyoxylyl, methoxy, methylenedioxy, glycolyl, hydroxyl, amide, nitrosyl, alkyloxy, cycloalkyloxy, aryloxy, alkenyloxyl, aralkyloxyl, aralkenyloxyl, radicals or groups, or combination.

106. The aforementioned compositions, wherein said composition contains an aralkenyl, cycloalkyl, cycloalkenyl, alkyloxy, cycloalkyloxy, aryloxy nitrate.

107. The aforementioned compositions, wherein said composition contain tetranitromethane, nitromethane,

nitroethane, or nitropropane and mixture.

108. The aforementioned compositions wherein said compound containing said non-lead element is silicon

109. The aforementioned compositions wherein said compound containing said non-lead element is potassium

110. The aforementioned compositions wherein said compound containing said non-lead element is manganese.

111. The aforementioned compositions wherein said non-lead derivative is selected from the group consisting of cyclopentadienyl manganese tricarbonyl, trimethylaluminum, pentaborane, decaborane, borazole, aluminimum borohydride, beryllium borohydride, dimethlylberyllium, or lithium borohydride, and mixtures.

112. The aforementioned compositions wherein said cyclopentadienyl manganese tricarbonyl is methylcyclopentadienyl manganese tricarbonyl.

113. The aforementioned compositions, wherein said nonleaded element's oxide's heat of formation is negative and equal to or greater than -150,000 gr calories/mole.

114. The aforementioned compositions, wherein said nonleaded element or derivative compound thereof has a minimum heating value of 5,000 Kcal/kg.

115. The aforementioned compositions, wherein said nonleaded element or derivative compound thereof has a minimum heating value of 7,000 Kcal/kg.

116. The aforementioned compositions, wherein said nonleaded element or derivative compound thereof has a minimum heating value of 9,000 Kcal/kg,

117. The aforementioned compositions, wherein said nonleaded element is contained in an organic or inorganic derivative compound.

118. The aforementioned gasoline compositions, where said compound containing nonleaded element is a cyclopentadienyl manganese tricarbonyl compound having a concentration amount greater than 0.008256 (1/32 gr/gal) gr/liter of Mn.

119. The aforementioned gasoline compositions, where said organic compound containing nonleaded element is a cyclopentadienyl manganese tricarbonyl compound representing a concentration amount no less than 0.016512 (1/16 gr/gal) gr/liter of Mn.

120. The aforementioned gasoline compositions, where said organic compound containing nonleaded element is a

cyclopentadienyl manganese tricarbonyl compound representing a concentration amount at least 0.033 (1/8 gr/gal) gr/liter of Mn.

121. The aforementioned gasoline compositions, where said organic compound containing nonleaded element is a cyclopentadienyl manganese tricarbonyl compound representing a concentration amount at least 0.066 (1/4 gr/gal) gr/liter of Mn.

122. The aforementioned gasoline compositions, where said organic compound containing nonleaded element is a cyclopentadienyl manganese tricarbonyl compound representing a concentration amount of 0.099 (3/8 gr/gal) gr/liter of Mn.

123. The aforementioned gasoline compositions, where said organic compound containing nonleaded element is a cyclopentadienyl manganese tricarbonyl compound representing a concentration is at least 0.132 (1/2 gr/gal) gr/liter of Mn.

124. The aforementioned gasoline compositions, where said organic compound containing nonleaded element is a cyclopentadienyl manganese tricarbonyl compound representing a concentration is at least 0.165 (5/8 gr/gal) gr/liter of Mn.

125. The aforementioned fuel compositions, wherein said non-lead metal or element represents no greater 10 grams of element per gallon of the composition.

126. The aforementioned compositions having a maximum sulfur content of 4,000 ppm.

127. The aforementioned compositions having a maximum sulfur content of 3,000 ppm.

128. The aforementioned compositions having a maximum sulfur content of 1,000 ppm.

129. The aforementioned compositions having a maximum sulfur content of 500 ppm.

130. The aforementioned compositions having a maximum sulfur content of 100 ppm.

131. The aforementioned compositions having a maximum sulfur content of 50 ppm.

132. The aforementioned compositions having a maximum sulfur content of 30 ppm.

133. The aforementioned compositions having a maximum sulfur content of 10 ppm.

134. The aforementioned compositions having a, maximum

aromatic concentration selected/from 35% volume.

135. The aforementioned compositions having a maximum aromatic concentration selected from 30% volume.

136. The aforementioned compositions having a maximum aromatic concentration selected from 22% volume.

137. The aforementioned compositions having a maximum aromatic concentration selected from 20% volume.

138. The aforementioned compositions having a maximum aromatic concentration selected from 15% volume.

139. The aforementioned compositions, wherein said hydrocarbons are alkylated hydrocarbons.

140. The aforementioned compositions, wherein said hydrocarbons are selected from the group consisting of benzene, toluene, m-xylene, ethylbenzene, o-xylene, isoproplybenzene, n-propybenzene, and mixture.

141. The aforementioned compositions, wherein said hydrocarbons are olefins selected from the group consisting of 2-methyl-2-butene, 2 methyl-1 butene, 1 pentene, and mixture.

142. The aforementioned compositions, wherein said hydrocarbons are branch chained or a condensed ring group hydrocarbons.

143. The aforementioned compositions, wherein said hydrocarbons are branch chain iso-paraffins, optionally selected from cyclopentane, n-pentane, 2, 3 dimethylbutane, isohexane, 3-methylpentane.

144. The aforementioned compositions, whereby resultant engine-out combustion gas temperature is reduced and fuel economy increased compared to fuel, absent said ECS compound.

145. The aforementioned compositions, wherein said compositions contain a nitrogen based compound selected from amines, anilines, amides, hydrazines, nitrosyls, imides, nitrates, dinitrate compounds alkyl nitrates, nitromethane, nitroethane, nitropropane, di-nitrat.es, amines, anilines, amides, hydrazines, nitrosyls, imides, nitro-ethers, anilines, nitro-ethers, amines, methylamines, amides, nitrdsyls, imides, monethylanile, aniline, ethylenediamine, isoethyl nitrate, methylamine, monoethylaniline, nitroglycerine, n-propyl nitrate, o-toluidine, triethylamine, trimethylamine, hydrazines, dimethyl hydrazine, monomethylhydrazine, methylhydrazine, symmetrical dimethylhydrazine, unsymmetrical dimethylhydrazine, xylidine, 2,3-xylidine, ammonia, ammonium nitrate, potassium nitrate, nitric acid, ammonium azide, ammonium perchlorate, nitrogen

trioxide, nitrogen dioxide, hydrazoic acid, dicyanogen, hydrocyanic acid, and mixture.

146. The composition of claim 131, wherein said compound is an organic derivative.

147. The composition of claim 131, wherein said compound is an alkyl or aryl derivative.

148. The composition of claim 131, wherein said organic nitrate is an alkyl nitrate, optionally selected from the group consisting of methyl nitrate, ethyl nitrate, isoethyl nitrate, n-propyl nitrate, iso-propyl nitrate, ethyl-hexyl nitrate and mixture.

149. The aforementioned composition containing additional sulfur additive.

150. The aforementioned method of claim 9, wherein average atomized particle size is 1 to 70 um (microns).

151. The aforementioned method claims, wherein average atomized particle size is no greater than 60 um (microns).

152. The aforementioned method claims, wherein average atomized particle size is no greater than 50 um (microns).

153. The aforementioned method claims, wherein average atomized particle size is no greater than 40 um (microns).

154. The aforementioned method claims, wherein average atomized particle size is no greater than 30 um (microns).

155. The aforementioned method claims, wherein average atomized particle size is no great.er than 20 um (microns).

156. The aforementioned method claims, wherein,average atomized particle size is no greater than 10 um (microns).

157. The aforementioned method claims, wherein average atomized particle size is no greater than 5 um (microns) .

158. The/aforementioned method claims, wherein said atomized particle is introduced by direct injection means.

159. The aforementioned method claims, wherein said atomized particle is introduced by turbo-charged means.

160. The aforementioned method claims, wherein said atomized particle is introduced by direct injection stratified charge means.

161. The aforementioned method claims, wherein said atomized particle or vapor is introduced by a swirl means.

162. The aforementioned method claims, wherein said atomized particle is injected under a pressure of 3 to 15 psi.

163. The aforementioned method claims, wherein the atomized particle is injected under a pressure15 to 45 psi.

164. The aforementioned method claims, wherein said composition is gasoline and the atomized particle is injected under pressure 1500 psi to 30,000 psi

165. The aforementioned method claims, wherein said atomized particle is introduced into an engine, combustor, or burner selected from group consisting of swirl combustors, spherical combustors, rocket engine, Brayton cycle engine, gas oil turbine, aviation jet turbine, diesel engine, marine engine, locomotive engine, aviation gas engine, automotive engine, oil burner, reside burner, oil furnace, oil burner, gas burner, gas furnace, internal compression engine, spark-ignited internal combustion engine, lean burn, fast burn, external combustion Stirling or Rankine engine, Otto cycle engine, lean burn engine, or catalyst system engine.

166. The aforementioned method claim wherein said combustor, engine or burner is operated lean.

167. The aforementioned method, wherein said combustion occurs in a turbine engine and wherein inlet gas temperature

does not exceeding 650°C.

168. The aforementioned method, wherein said mixture contains at least one compound selected from the group consisting of a polyolefinj polyacrylate, polymethacrylate, modified polystyrene, ethylene-vinyl acetate copolymer, or ethylene-vinyl chloride copolymer, and mixture.

169. The aforementioned method, whereby resultant engine-out combustion gas temperature is reduced and fuel economy increased compared to fuel, absent said ECS compound.

170. The aforementioned method, wherein in combustion said method is characterized as resulting in a luminous reaction zone extending distance from the surface of said non-lead element or derivative compound.

171. The aforementioned method, wherein in combustion said method is characterized as resulting in the formation of oxides of said non-lead element or derivative compound in the submicron range.

172. The aforementioned method employing COMBUSTION CATALYST compound wherein said mixture is introduced into the engine of a Tier II vehicle (gasoline or diesel), where by polymerization occurs at a temperature exceeding

100/125/140/150/160/165/170/175/180°C.

173. The aforementioned method employing COMBUSTION CATALYST compound wherein said mixture is introduced into the engine of a Tier II vehicle (gasoline or diesel) with contrations of sulfur exceeding 30/50/100/150/200/250/300/350/400 ppm, whereby catalyst or after treatement emission systems are not adversely effected or disabled.

174. The aforementioned method employing COMBUSTION CATALYST compound wherein said mixture is introduced into the engine of a Tier II vehicle (gasoline or diesel) whereby fuel economy is improved at least 2/5/8/10/15/20% above clear fuels absent ECS, COMBUSTION CATALYST and optionally NLEC components.

175. The aforementioned use, wherein:

a. the ECS oxygenate is selected from the group consisting of carbon monoxide, methylene dimethyl ether, carbonic acid dimethyl ester, carbonic acid diethyl ester, dimethyl ether, diisopropyl ether, methyl tertiary butyl ether, ethyl tertiary butyl ether, methyl tertiary amyl ether, ethyl tertiary amyl ether, methanol, ethanol, iso-propanol, tertiary butanol, iso-butanol, and mixture thereof,

b. in an unleaded hydrocarbon base containing a cyclopentadienyl manganese tricarbonyl (CMT) compound

c. to improve fuel economy of an internal combustion engine.

176. The aforementioned use, wherein the oxgenate concentration is no less than 1.5% weight percent.

177. The aforementioned method claims and compositions characterized in combustion as having a luminous reaction zone.